



AUSTRALIAN communications

FEBRUARY 1994

The Networking and Telecommunications Management Magazine

\$5.50

HIGH-SPEED LANS

Which technology will win the race
for market share?

NETWORKING STAKES



2-1	ATM
EVENS	100VG-ANYLAN
10-1	FAST ETHERNET
500-1	HIGH SPEED TOKEN RING
10-1	FIBRE CHANNEL
100-1	FDDI
100-1	FDDI OVER COPPER
500-1	FDDI II
100-1	ISOCRONOUS ETHERNET
500-1	FFOL



BUYING A WAN
Part #2 of our eight
vendor play-off

THE TN3270 PROTOCOL
Running SNA over a TCP/IP
backbone without the fuss

ATM CPE
First generation products
hit the streets

THE FACTS ON FAX
Does plug-and-play really
mean plug-and-pay?



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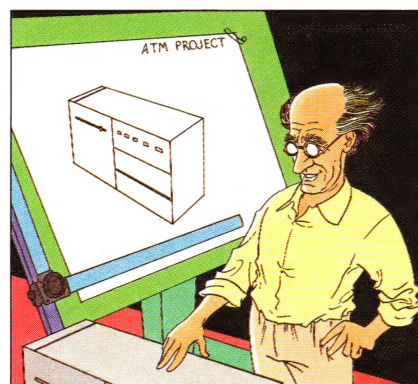
As a result, we are delivering innovative telecommunications products
and services to our customers throughout the world.

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products that are generating sales for NorTel both here and overseas.
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And it's a business connection that's paying dividends for Australia too.

NorTel. Discovering and delivering the world's best solutions
in telecommunications.

AUSTRALIAN communications

Cover: Tony Pyrzakowski



HIGH-SPEED LANS

59

Prospective users of high speed local area network technologies face a bewildering array of technology choices: at least four flavours of Fibre Distributed Data Interface (FDDI), three kinds of Ethernet, Fibre Channel, high-speed Token Ring and even Asynchronous Transfer Mode (ATM). Each of these options has its own set of powers and abilities: for instance, some are suited to handling multimedia traffic, while others only come into their own when pushing bulk asynchronous data packets. There's only one way to sort through the technology tangle to find the best solution for a given network application — that's to take a crash course in high-speed LAN alternatives.

BUYING A WAN

73

Faced with the same set of specifications, how would Australia's leading WAN vendors respond? In the second part of our third annual wide area networking survey we present solutions to the wide area network requirements for our fictional corporate alter-ego, AusComms, from Datacraft, Ungermann-Bass and JNA Network Services (last month we examined solutions from 3Com, Digital, GEC Alsthom, MPA International and Toren Computer Communications). In addition, we also present a solution from Moresdawn Pty Ltd, the consultancy charged with putting together AusComms' set of requirements, and we take a look at how close you can go to building a 100% Australian-made wide area network.

ATM CPE

85

Tall tales about seamless mesh networks carrying voice, video and data may make for sweet dreams but it's time to wake up and find out what ATM can and can't do for net managers looking for zippiest LANs and bandwidth to burn on their WANs. Seamless? Someday, but right now most managers are likely to be deploying ATM switches on the campus, using the technology to interconnect LANs. ATM on the LAN is possible but pricey, although private network switches are making it a very attractive alternative on the wide area. Putting it all together means knowing what equipment is now on the market and what interoperability issues remain to be ironed out.



FAX FACTS

99

Like most of us, you probably bought your office facsimile machine, plugged it in and forgot about it. Facsimile machines are the ultimate in plug-and-play devices, the forerunners of a world free from interoperability problems and resort to usually unfathomable user manuals. Or are they? Stewart Fist explains that plug-and-play fax performance is a result of a series of technical compromises that can result in less than perfect performance. So the next time you receive multiple copies of the same fax, don't ring up and abuse the sender for wasting your fax paper; instead, save your curses and check the configuration of your fax machine.

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Ericsson, Alcatel and Siemens emerged as the big winners in Telecom Australia's landmark Mode of Operation supply view — but at what cost?

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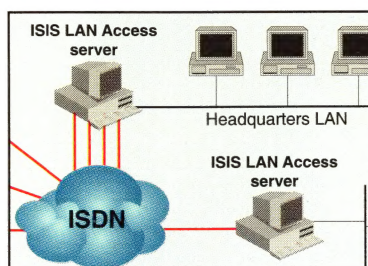
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Sliding Madge's Hubcard into a server allows net managers to set up and manage small Token Ring sites.

48 HP's No-Frills LAN Analyser

HP's J2300A protocol analyser delivers functions net managers need without costly features they don't.

49 The ISIS Way to ISDN

ISIS ISDN adaptors simplify the problem of providing branch office access to the corporate WAN.

group of business leaders with a direct involvement in both the IT and communications industries.

LEGAL LINE



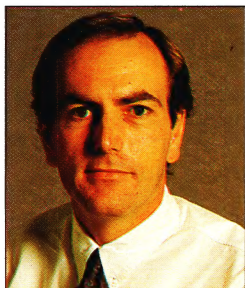
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The admissibility as evidence of electronically created or stored documents in court remains a risky proposition. Reay McGuinness considers the problems and suggests some steps to minimise the risk.

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The Revolving Door



Why don't they install a revolving door on the office of the Communications Minister? With the Pay TV fiasco spelling the demise of Senator Bob Collins as Minister for Transport and Communications and David Beddall as Minister for Communications, the Communications portfolio has again changed hands and the man in the hot seat this time is former Minister for Tourism and Minister for Resources, Michael Lee. He follows in the footsteps of David Beddall, Graham Richardson, John Kerin, Kim Beazley and Ros Kelly, all of whom have held responsibility for the portfolio for varying periods since 1989.

Prompted by the resignation of John Dawkins, Prime Minister Keating also took the opportunity to change the shape of his ministry and the Communications portfolio has now been separated from Transport. Another change is that the Communications portfolio has now been deemed unworthy of its own Minister. Mr Lee retains his responsibility for Tourism and will now be styled Minister for Communications and Minister for Tourism. While it's true that this is not the first time Communications has been lumped in with something else, it is a little curious that two of the most important areas of our economy are deemed to be unworthy of a full-time Minister. Tourism is one of our biggest export earners while communications has the potential to become so.

With the sort of attrition rate suffered by his predecessors Mr Lee could be excused if he displays a reluctance to bury himself in the detail of the industry; after all, the odds on his longevity in the post aren't that good. If that proves to be the case then he may well choose to spend the bulk of his time concentrating on his Tourism portfolio and leave Communications to the many senior bureaucrats who have now been around for a very long time.

M Smeaton



Optus 405 Mobile Phone Winner

On December 1 we drew the prize-winning entry for our latest subscription competition, in which readers were given the chance to win an Optus 405 mobile telephone and airtime package worth \$1,450. The lucky winner was Mark Northover from Mulgrave in Victoria, who received his brand new Optus phone just in time for Christmas. The winner's name was picked from the box by Optus' Marketing Manager, Mobile, Tony Miller, at Optus' Sydney office. *Australian Communications*' Deputy Advertising Manager, Dawn Switzer, was also present to supervise the draw.

AUSTRALIAN communications

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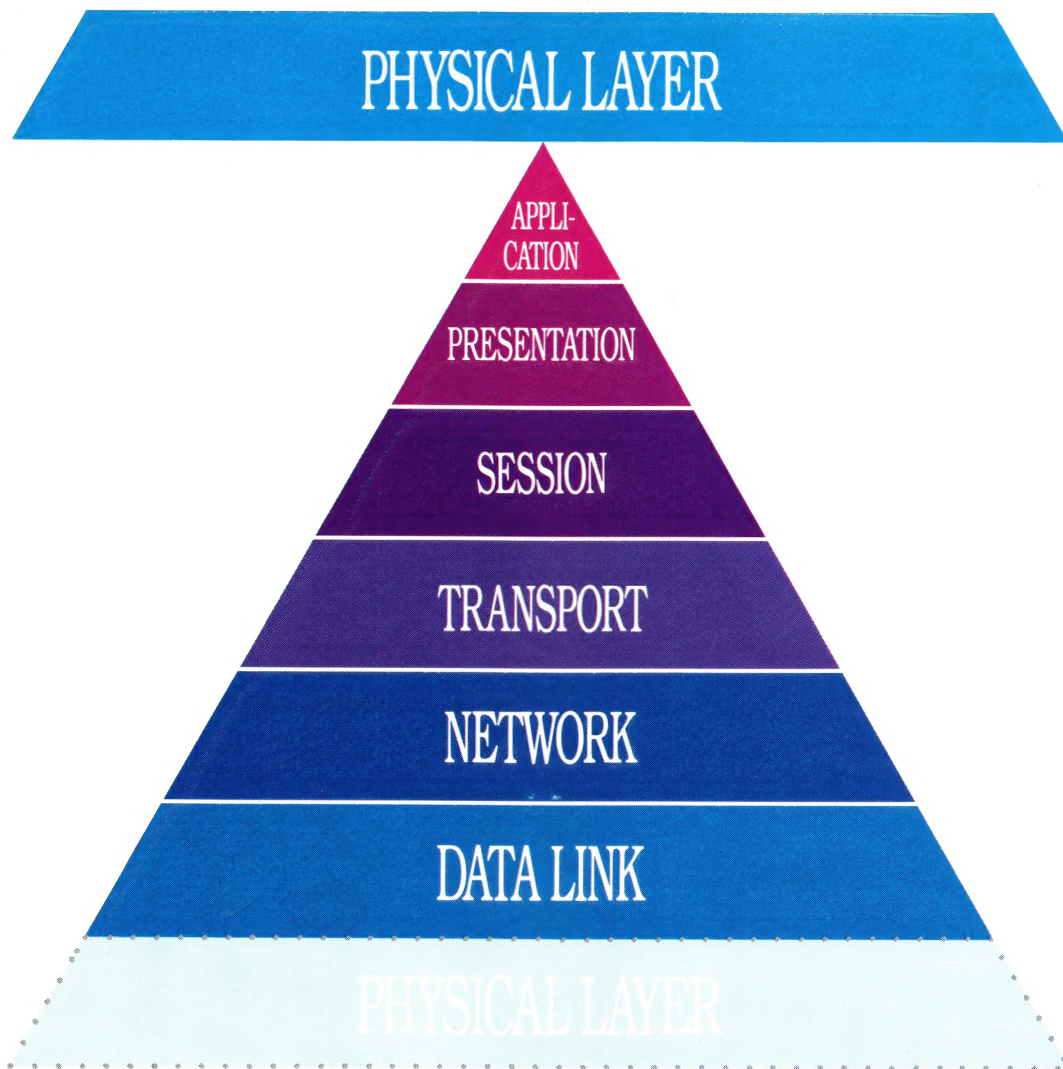
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Are you making physical layer decisions a top priority?

The wiring system, or physical layer, upon which your entire communications system is built may only constitute a small portion of your investment but can cause the vast majority of your network problems. How can you be sure, with technology and industry standards changing so rapidly, that your system can run the high speed applications your business demands?

You can call Anixter. We have made the Physical Layer our business. We play a vital role in all the standards committees, but standards alone aren't the answer. You also need to sort out the wide array of available technologies. Only Anixter can help you do that. We provide solutions that meet your specific requirements. For Total System Performance, call Anixter.

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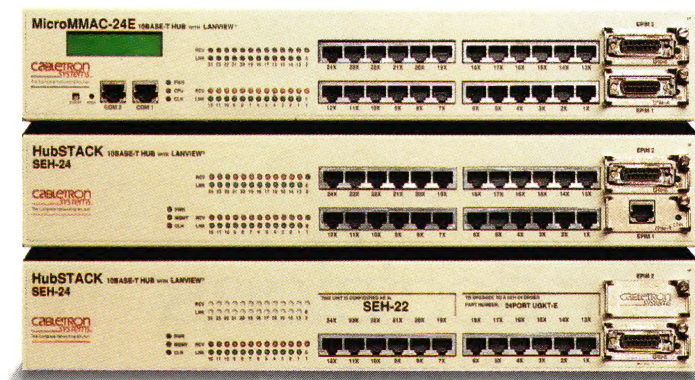
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THE NEXT GENERATION

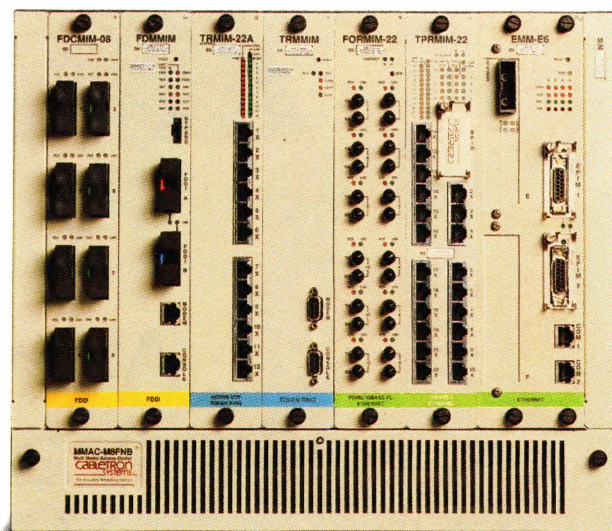
FROM END TO END, CABLETRON



Remote Sites

The Next Generation Gap — it's that vast canyon between the revolutionary information networks of tomorrow, and the data networks you rely on today. How safely you cross over, and in what shape you find yourself, will depend largely on the vendor decisions you make in the months to come.

Many vendors have already announced their next generation solutions. Upon closer scrutiny, you'll find them to be nothing more than enhancements to existing technologies. Cabletron is about to unveil something



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GENERATION GAP

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completely new: a true migration path from shared access to switched access networks. It will ensure safe passage to tomorrow's information networks, and bridge the gap between the revolution you expected and what the other vendors delivered. Watch for it.

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Telstra Consortium Wins HK Licence

Telstra has gained a toehold in Hong Kong and a potential stepping stone to the Chinese market following the awarding of a fixed line licence in the territory to Hutchison Communications late last year. Telstra has a 20% stake in Hutchison Communications, with the remaining 80% held by Hutchison Whampoa.

Two other bidders have also won licences: New T&T Hong Kong, 100% owned by Wharf Holdings, but with a technology 'partnership' with Nynex; and New World Telephone, which comprises New World Development (66.5%), Infa Telecom Asia Ltd (3.5%) and two 'technology partners,' US West International (25%) and the Shanghai Long Distance Telecommunications Bureau of China's Ministry of Posts (5%).

Subject to approval by Chinese authorities, the new licence holders can compete in fixed line voice services from July 1995 when Hong Kong Telecom

(HKT) loses its domestic monopoly. However, HKT will monopolise the lucrative international voice sector until 2006.

Hutchison Communications will focus on the business sector and the new licence will complement Hutchison's existing cellular services and the telepoint system operated by a Telstra joint venture. Hutchison also has a stake in AsiaSat and in the Star TV satellite TV service controlled by News Corp.

New T&T Hong Kong's sister company, Wharf Cable, began offering a cable TV service last October. HKT, which is controlled by Optus shareholder, Cable & Wireless, is also seeking permission to offer TV services on its cable network when Wharf's exclusive licence ends in mid-1996.

New World is positioned to offer TV, voice and data services given its 45% stake in Asia Television, one of the two terrestrial TV companies.

ABA Chief to Head Expert Group

Brian Johns, current Chairman of the Australian Broadcasting Authority, has been appointed Chairman of the Broadband Services Expert Group, the committee charged with exploring the viability of running broadband communications services to Australian homes.

Dismissed as another election gimmick when announced by Prime Minister Keating before the 1993 federal election, the Expert Group idea has nonetheless developed momentum, not least because of the support of the ACTU which sees the job

creation potential of a national fibre-to-the-home project.

According to its terms of reference, the Group will examine and report on 'the technical, economic and commercial preconditions for the widespread delivery of broadband services to homes, businesses and schools in Australia.' It will also examine the R&D and training requirements for economic use of the new services, and, most importantly, identify likely funding arrangements. The Group is expected to deliver a draft report by the middle of the year.

The Broadband Services Expert Group

Brian Johns	Chairman, Australian Broadcasting Authority
Duncan Black	Managing Director, GE Information Services
Dennis Cooper	Chief, CSIRO Division of Radiophysics
Alf Forster	National President, Communication Workers' Union
Patricia Gillard	Research Director, Telecoms. Needs Research Group
Bruce Gyngell	Executive Chairman, Nine Network Australia
Alan Horsley	Managing Director, Vistel
Laurie Mackechnie	Group General Manager, AWA
Gerry Moriarty	Managing Director, Network Products, Telecom Australia
Ross Ramsey	Manager, Government Liaison, Optus Communications
Trevor Wisemantel	Chief Manager, Voucher Processing, Westpac
Ian Reinecke	Chairman, Info. Policy Board, Dept. of the Premier, Economic and Trade Development, Qld.

Uni-Lab Deal Pays Off For Stanilite

Technology first developed by failed manufacturer Uni-Lab Telecommunications has landed Stanilite Electronics multi-million dollar overseas supply contracts and helped the company win funding from Austrade. Developers of trunk and cellular radio equipment, Uni-Lab was purchased by Stanilite in 1992.

In Argentina, the Compania de Telefonos del Interior (CTI) placed a \$16 million order for 70 Cellswitch cellular radio systems late last year. A condition of the deal was that the systems had to be supplied and installed before the end of this month.

Installation was also included in a \$1.5 million contract won by Stanilite for the supply of seven Trunkswitch base stations and other equipment from the Botswana Power Corporation. Trunkswitch trunk radio technology was also first developed by Uni-Lab.

Hoping to help Stanilite to build on these successes, Austrade has now weighed in with two loans totalling \$2.3 million for further overseas marketing, particularly in Europe and Asia.

Nokia Expands R&D Activities

Nokia has expanded its R&D presence in Australia with the opening of a new transmission systems R&D facility in Melbourne. The company's first facility of its type outside Europe, the new Transmission Systems Centre of Excellence will focus its activities on technologies such as SDH, ATM and HDSL.

Nokia Telecommunications Australia Managing Director, Pertti Melamies, says the company will spend more than \$10 million over the next five years on the new facility, which will complement its GSM Centre of Excellence in Sydney and GSM R&D operation at Wollongong University.

Nokia's sales in the Australian region came in at around \$130 million last year.

Yet Another New Minister

The Ministerial reshuffle prompted by the resignation of former Treasurer, John Dawkins, has led to the appointment of yet another new Minister for Communications and the splitting up of the Transport and Communications portfolio.

Michael Lee is the new Minister for Communications and Minister for Tourism. Previous Minister, David Beddall, is now Minister for Resources. Former Transport and Communications Minister, Senator Bob Collins, is now Minister for Primary Industries and Energy.

Lee has degrees in Science and Electrical Engineering and worked for the NSW Electricity Commission before winning the NSW central coast seat of Dobell in 1984. He became Minister for Tourism and Minister for Resources in March last year.



Michael Lee

AAPT Upgrades

AAPT Telecommunications has signed a multi-million deal with US supplier DSC Communications for the supply of four new MegaHub toll switches.

The new switches will be deployed in Brisbane, Adelaide, Canberra and Perth this year and will complement two existing MegaHubs in Melbourne and Sydney. Each switch will provide AAPT with an expansion capacity of 120,000 ports said DSC Communications Director, Graham Darley.



Telstra CEO, Frank Blount (left), with the company's Manager, International Network Operations, Phil Green

Telstra's New International Gateway

Telstra's ability to respond to outages in its international network has been enhanced significantly after the commissioning late last year of the carrier's new international Network Operations Centre in the eastern Sydney suburb of Paddington.

Designed and built by Telecom staff, the new centre provides a total, integrated view of Telecom's links to more than 200 countries. Its role is to manage all of Telecom's international facilities, including trans-

mission equipment, exchanges, and submarine cable systems.

According to Telstra CEO, Frank Blount, the centre dramatically enhances Telstra's ability to handle network faults. For example, if a breakage occurred on the PacRimEast fibre optic cable, the centre could manage a full restoration of services within two hours, compared to the 12 hours an equivalent restoration would have taken three years ago, he said. The goal is to cut this to two minutes by 1995.

Olex Wins \$55M Indian Contract

Olex Cables has won its second major contract in India to supply and construct a fibre optic based communications and pipeline monitoring system. The new \$55 million deal with the Indian Oil Corporation follows the successful completion last year of a similar project for the Indian Petrochemicals Corporation.

The new project involves the installation of a 1,500 kilometre cable alongside a pipeline linking Kandla, on the north west coast of India to Bhatinda, 250 kilometres north west of New Delhi. Olex's responsibilities extend to constructing 23 repeater sites and compounds, organising power requirements at 35 sites and the installation of a complete distributed telephone network, said Olex Group General Manager, Andrew Stobart.

NorTel to Supply BT in NSW

NorTel has won a \$10 million contract from BT Australasia for the supply of switch and PABX equipment for the BT-managed NSW Government network. BT has also awarded a \$2 million contract to Hansen Corporation for software development and a further \$1 million contract to James Hardie Industries for repair and maintenance services.

Under the BT contract, NorTel will supply the three DMS-100 SuperNode switches and 13 Meridian-1 PABXs which BT will use to form the backbone of the network, which will eventually link 5,000 sites, 120,000 telephones and 23,000 computer terminals. Australian equipment supplier, Exicom, will participate in the manufacture of the equipment though its strategic alliance with NorTel.

In Brief

Austel says that Optus secured 14% of telephone lines in Melbourne but only 10% in the Geelong and Mornington Peninsula areas after preselection balloting in those regions.

Hewlett-Packard Australia has announced that its total revenues rose by 34% to \$496 million for its 1993 financial year. Net profit rose by 160% to \$28.6 million. HP's Australian Telecommunication Operation grew by over 120%.

Telecom has received seven prime vendor bids for the supply of an end-to-end cable TV system. The bidders are: Scientific Atlanta, Ericsson Australia, AT&T Australia, NEC Australia, NEC Australia, Philips, Pacific Broadband Networks, and FUBA/SAM Technology. A winner may be selected by early March.

Digital Equipment Corporation has appointed Ron Bunker as its Managing Director, South Pacific Region. Currently Vice President, Global Sales Operations, Bunker replaces Ron Larkin who is returning to Canada to become President, Digital Canada.

Telecom has decided to adopt a Standard Operating Environment (SOE) for its Unix-based midrange systems. Under the SOE, Hewlett-Packard and Sun have been selected as preferred suppliers of hardware and services, while Ingres and Oracle have become the preferred relational database suppliers.

Microsoft Australia has appointed Chris Kelliher as its latest Managing Director. Kelliher has been the Managing Director of Microsoft New Zealand since 1991.

Telecom Plus was last month scheduled to launch an international frame relay service through its links with the SprintNet Global Frame Relay Service. The service will initially be available from nodes in Sydney and Melbourne.

Telecom had signed up over 1.5 million customers to over 2.7 million Flexi-Plans by December last year. Of these, about 1.4 million were taken up by residential customers, 700,000 by business customers and 600,000 by MobileNet users.

INC Manufacturing has won accreditation to the AS 3902 Quality Assurance standard. Equivalent to ISO 9002, AS 3902 covers 'quality systems for production and installation.'

Telecom says that it will soon begin equipping major business offices with optical fibre in a \$45 million program over the next five years. The new cabling will help business take better advantage of Telecom's evolving SDH-based network backbone.

Com Tech Communications will hold its 4th annual Open Systems Forum at the Hyatt Cooloom in Queensland on March 11-14. This year's Forum will attract over 400 end users and dealers and feature addresses from Telstra CEO, Frank Blount, and SynOptics Communications' Chief Technical Officer, Ron Schmidt.

Telstra has appointed David Krasnostein to the newly created legal position of General Counsel. Born in Australia, Krasnostein has worked as a corporate attorney in the US since 1981.

Austel has opened a Bulletin Board System to improve public access to standards information. The BBS telephone numbers are: (03) 828 7495 and (03) 828 7477.

Standard Microsystems Corporation (SMC) has appointed Sydney-based LAN Systems as the third Authorised Master Distributor of its enterprise hub product line. Tech Pacific and Westan are the other established distributors.

ATUG '94 exhibitors will have the opportunity to attach to an in-show network in order to display their solutions in a realistic environment, say show organisers Riddell Exhibition Promotions. The network will be based on an FDDI backbone.

Stuart Corner Information Services, publisher of telecommunications newsletters *Exchange* and *Telenews Asia* has acquired the *Communications Report* (CR) and *Asia Business Report* (ABR) newsletters formerly published by CR Publishing. CR and ABR subscribers will receive either *Exchange* or *Telenews Asia* for the duration of their existing subscriptions.

FNA (Financial Network Association), the 12-carrier consortium established over 18 months ago to serve the finance industry is now offering services, according to group member Telecom.

In Brief

Novell has reported net revenues of \$US1.123 billion for its latest financial year ended October 30, 1993 — a boost of 20% over 1992. After accounting for a write-off of \$US320 million for purchased research and development and other costs associated with acquisitions, the company posted a net loss for the year of \$US35 million. Excluding the impact of the write-off, earnings for the year rose by 13% to around \$US282 million.

Nokia has been chosen by French GSM operator, SFR, to supply base stations for its GSM network. SFR plans to use the equipment to build the first micro-cellular networks in France.

3Com has reported sales of \$US205.3 million and net income of \$US21.5 million for the quarter ended November 30, 1993. The results are increases of 34% and 131% over 1992 and represent the strongest sequential growth in the company's history.

WTAC, the World Telecommunications Advisory Council, has recommended that the ITU proceed with the feasibility stage on WorldTel — a funding and development organisation to promote telecommunications growth and expansion on a worldwide basis.

PTT Telecom Netherlands has signed an agreement with Ericsson to distribute Freeset, Ericsson's cordless DECT-based PABX system. The PTT is the first to market Freeset based on DECT.

SITA and Unisource have announced a new alliance designed to provide multinational companies with seamless global data communications services. SITA provides telecommunications services for the world airline industry. Unisource is a pan-European supplier of telecommunications services owned by PTT Telecom Netherlands, Sweden's Telia and Swiss Telecom PTT.

PCS development in the US has received a boost following an agreement reached by MCI, Northern Telecom, Ericsson, Nokia, Telular Corporation and MIT Lincoln Laboratory to develop open PCS specifications which are interoperable with GSM.

GPT is to supply MFS Communications with SDH equipment for its City of London network. MFS was awarded a licence to build an optical fibre network in London's financial district late last year.

Tilts Communications, a Cable and Wireless (70%) and Telecom Finland (30%) joint venture has won a 49% stake in Latvia's state-owned telco, Lattelekom. Tilts will invest \$US160 million over the next three years to provide Latvia with a digital network.

Belgacom has announced that it gained 2,512 customers for its GSM service in the week following its January 1 launch. The network, named Proximus, is being run jointly with Pacific Telesis.

Bell Atlantic and Sweden's Telia have signed an agreement to determine how Bell's Advanced Intelligent Network (AIN) solution can be deployed in Telia's network.

Oftel, the UK telecommunications industry regulator, has reported that consumer complaints and enquiries concerning telecommunications have fallen from 41,000 in 1992 to 27,000 in 1993. An Oftel survey has found that 87% of customers were satisfied with BT and 58% thought its service offered value for money.

Digithurst, a UK-based company will invest ECU1.8 million in the Aclara project which is designed to link the towns of Chateau du Loir in France and Ganderkesee in Germany with an experimental multimedia communications link. Half of Aclara's funding has been provided by the EC's Race program.

Scientific Atlanta is planning to establish a pan-European VSAT satellite network in conjunction with the UK's BT Visual and Broadcast Services. Construction of a satellite hub has begun in London and is expected to be completed early this year. In Europe, construction will initially start in Paris.

Network General, a leading United States-based supplier of network analysis products, has announced plans to purchase rival software developer, ProTools.

Nokia will provide China Railways with digital switching transmission equipment starting early this year in a deal being financed by the Overseas Economic Cooperation Fund. Nokia will provide DX200 switching systems, multiplex and cross-connect equipment for the Zhengzhou, Lanzhou and Jinan Railway Bureaus. The company will also provide comprehensive management systems for switching and transmission.

FT and DBT in Global Venture

France Telecom (FT) and Deutsche Bundespost Telekom (DBT) have announced plans to form a new joint venture company to provide a range of global business services. The deal coincides with suggestions that cross-shareholdings between the companies was under consideration.

Expected to be operational in 1995, the joint venture will provide X.25, frame relay, international point-to-point links and VSAT services, as well as international virtual private voice networks. Headquartered in Brussels, the venture will generate

revenues of around ECU1.5 billion in its first year of operation and employ around 4,000 staff. It will offer centralised billing, and one-stop shopping. Recognising the need for a US partner, DBT chairman, Helmut Rieke, said that discussions with AT&T were taking place.

Rieke also hinted that an FT-DBT cross-shareholding was envisaged — but not before the liberalisation of European telecoms in 1998. Rieke said that negotiations had not included a merger of the two companies. (*TelecomEuropa*)

Italian ATM

Alcatel and Ericsson have won contracts with Italy's SIP to provide ATM nodes to connect Italy to the pan-European broadband network. Alcatel Italia will supply an international gateway node in Milan together with another node with nationwide functions, while Ericsson Fatme will supply a third node.

Fifteen countries are participating in the broadband network project, including the UK, Germany, Sweden and Portugal.

MCI's Vision

The US National Science Foundation Network has signed on as MCI's first customer for its new fibre-based New York-Los Angeles link which operates at speeds 15 times faster than existing SONET technology. The link is the first element of MCI's 'networkMCI' strategy.

The new strategy has also resulted in the creation of subsidiary, MCI Metro, which will invest \$US2 billion in fibre infrastructure in major US cities.

Pacific Bell's \$US16B Plans

US RBOC, Pacific Bell, has announced plans to spend \$US16 billion over the next seven years on the construction of an integrated network designed to provide its customers with voice, data and video services. The initial focus will be on the San Francisco, Los Angeles, Orange County and San Diego areas, with a planned 5 million homes connected to the new network by the end of the decade.

The network will be built by AT&T with fibre deployed from Pacific Bell facilities to neighbourhood locations and signals switched via coax to AT&T-developed remote units in customer homes. Present customer telephone and cable wiring inside the home will be unchanged.

Hungary Selects GSM Winners

Hungary will be the first country in eastern central Europe to implement GSM following recent contracts awarded by Pannon GSM and Westel 900.

A consortium of three Hungarian companies, Telecom Finland, Tele Denmark, Tele Norway and the Dutch PTT, Pannon GSM has selected Nokia as its network supplier. Plans call for the network to cover main roads and cities by the end of this year and 90% of Hungary's 10 million population by 1997.

Westel 900 is a joint venture between Hungarian telecommunications operator Matav and US West. Ericsson has been selected as its system supplier and coverage plans are similar to rival Pannon GSM.



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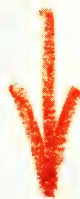
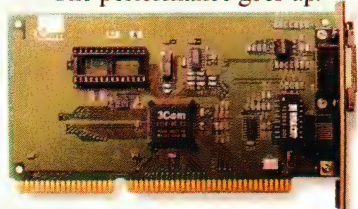
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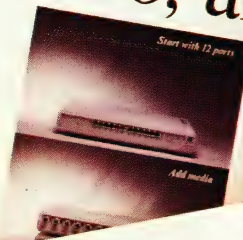
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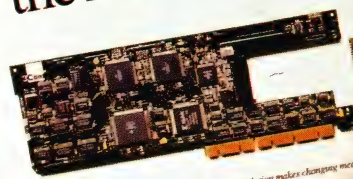
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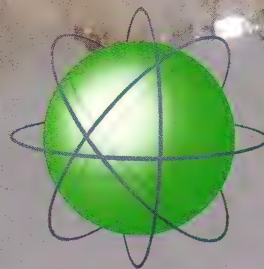
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Putting the Squeeze on Suppliers

Ericsson, Alcatel and Siemens emerged as the big winners after Telecom's Future Mode of Operation review — but at what cost?

Few local telecommunications industry players have the courage, clout or inclination to publicly criticise Telecom's much-trumpeted Future Mode of Operation (FMO). But some sections of the industry feel that Telecom has responded to the emerging competition from Optus and Vodafone in the business end of the market by maximising its earning potential in the residential sector, where it retains a monopoly. In the process, suppliers like Ericsson, Alcatel and Siemens have had to partly wear the cost by reducing their margins. And according to some observers, this policy is reflected in NorTel's relatively poor showing in the FMO beauty contest, despite an almost sacrificial offer on its high-end switches which lead the market in the provision of business services.

Clearly, the FMO strategy has as much to do with the tone and thrust of Telecom's relationships with its major suppliers as it has to do with digitalising and upgrading the nation's telecommunications backbone.

While Telecom is fond of the term 'world best practice' in relation to its operations and services, it's also seeking 'world best value' from its suppliers — a euphemism for maximum bang for the buck. Just as it put the squeeze on staff numbers and management, it's a sure bet that commercial pressures will see Telecom driving the hardest bargains from its suppliers through the 1990s and beyond.

As Telecom sees it, FMO is all about strategic partnerships and this means closer cooperation at all levels of product design, manufacture and marketing. Gone are the days when, as one industry observer put it, "Telecom threw a tender over the fence and waited for the best offers to come back."

"It's a much deeper relationship and one that recognises the interdependence that exists between us and our suppliers in a competitive environment where we need to deliver high quality products and services as quickly and reliably as possible," said Telecom's Managing Director, Network Products, Gerry Moriarty.

Customised for Australia from models in Europe, the US and Japan, the new relationships would mean more meetings between Telecom and its suppliers, from the lowest to the uppermost levels, Moriarty said. "Strategic relationships are talked about a lot in the 1990s but when you look for practical models there aren't a lot, so we hope to be ahead of the field."



The corporation had achieved "outstanding value in all areas" in its deals, Moriarty said. These came to \$2.45 billion of a budgeted FMO total of \$3.3 billion (\$600 million is earmarked for internal expenses). The closer relationships would also increase accountability by the suppliers, underpinned by penalty clauses which Telecom would enforce rigorously, Moriarty said.

Using the example of the \$500 million transmission contract signed with Siemens at the expense of rivals NEC, Philips and Alcatel, Moriarty said: "We have taken a lot of time to ensure that, as the sole transmission supplier, they are able to meet our requirements. But we reserve the right to introduce another transmission supplier if this arrangement fails."

Close to World Minimum Price

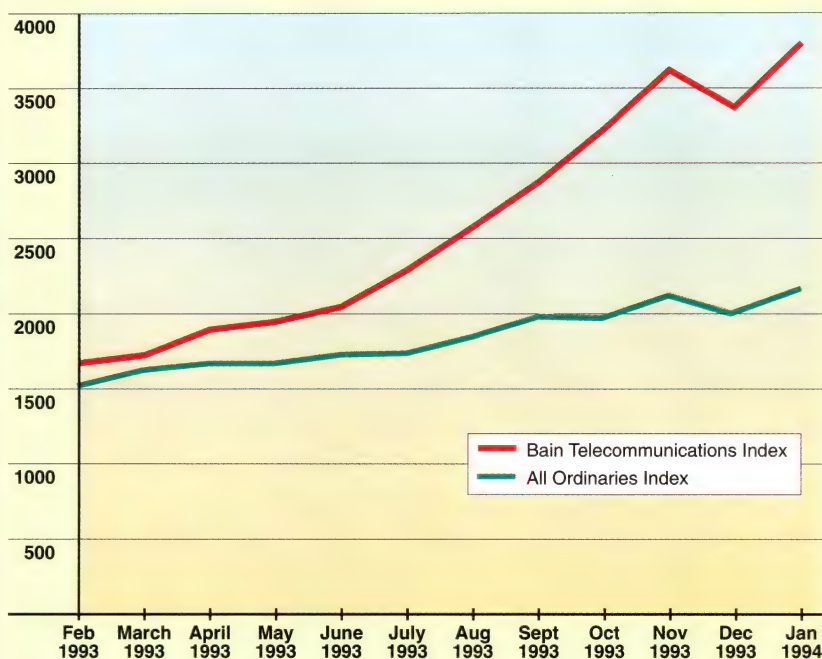
"It was a very competitive process in light of the substantial volumes of equipment involved and we made it very clear that we wanted world best value in terms of price, service and features," Moriarty said. By entering strategic partnerships for the FMO upgrade, Telecom had made savings "in the

hundreds of millions" based on the large volumes and the huge efficiencies Telecom would achieve by building the new network all in one go. Rough estimates among industry leaders put the cost of implementing the FMO at around \$150 per line, which they said would come close to the world minimum price.

While the FMO was largely about upgrading the network backbone, Moriarty said Telecom, using intelligent network equipment from its third switching supplier, NorTel, would be aggressively pursuing the high-end business market where facilities management companies and value added service providers such as Pacific Star and BT were scoring impressively. "It's a small but high-revenue niche which Telecom has helped build up based on NorTel's DMS equipment," he said. "But in terms of the mass switching sector, it's self-evident that our business with NorTel will be significantly less because the DMS is designed for a high-end niche."

While Moriarty conceded that the new fully digitalised network would inevitably lead to staff cuts because it would handle

Stock Watch



The Bain Telecommunications Index (BTI) includes only those public companies which derive the majority of their earnings from the telecommunications sector. It is calculated in the same fashion as the All Ordinaries Index and is maintained by the Australian Stock Exchange Index Office. The formula is:

$$\text{Today's Closing BTI} = \text{Yesterday's Closing BTI} \times \frac{\text{End of Day AMV}}{\text{Start of Day AMV}}$$

where AMV refers to Aggregate Market Value - i.e. total market capitalisation. The start of day AMV is the previous day's end of day AMV and is adjusted for any changes in the BTI such as additions, capital reconstructions, rights issues etc. This ensures that any movements in the BTI are the result of trading activity in that day only.

Company	Market Capitalisation \$M	Performance %	Share Price (\$)		
			1/1/94	52 Week High	52 Week Low
AWA	150.8	-19.6	0.74	0.88	0.59
Datacraft*	38.2	490.0	0.59	0.68	0.10
ERG Australia	360.2	188.4	2.95	2.96	1.05
Exicom	124.3	173.3	1.23	1.40	0.41
JNA Telecommunications	95.0	113.3	3.20	3.40	1.40
Matrix Telecommunications*	130.8	390.9	2.70	2.90	0.52
Scitec*	14.0	420.0	0.23	0.30	0.04
Stanilite Pacific	161.4	121.2	5.50	5.50	2.58
Techniche	81.8	376.8	3.91	4.55	0.82

*Not currently in the All Ordinaries Index

Market capitalisation is the share price multiplied by total ordinary shares on issue.

Performance is the percentage share price movement over the past 12 months.

Source: Bain & Company

greater traffic volumes faster and require less maintenance, he stressed that the FMO budget, as the largest single telecommunications investment in Australia's history, would provide a major boost for local equipment manufacturers and suppliers.

Ericsson's Manager, Business Analysis, Jimmy Lynch, said his company was "satisfied" with the \$850 million contract to supply AXE Plus switches for half the new local access exchanges and to maintain the older-generation AXE units. "There's no

doubt Telecom has cut the best possible commercial deal for themselves. But Telecom also knows that bad business — non-profitability — is no good to either customer or vendor. The nature of telecommunications is that, because of the huge expenditures in R&D and support, you have to have a reasonable return if you are going to remain viable."

A significant slice of the \$1.1 billion contract awarded to Alcatel was probably for Remote Integrated Multiplexers (RIM), for which Ericsson had also bid, Lynch said. Alcatel's contract, which confirms it as a primary switching supplier despite industry rumblings about its System 12 switch's performance, is to deliver over three million lines from digital exchanges and another two million lines from transit exchanges and RIMs.

Lynch said the FMO and other contracts had left Ericsson and Alcatel on an even par in their commercial relationships with Telecom. Ericsson's 80% dominance in providing the Australian GSM network, confirmed late last year with an \$80 million contract to supply all major Australian centres, rather than just Melbourne, Adelaide and Perth, partially made up for Alcatel's success with transit exchanges and RIMs, he said. "In terms of our broader role in the telecommunications industry, we're also the major supplier to Vodafone." Lynch also pointed to the recent Ericsson contract to supply a GSM system to a joint venture between Fiji Posts and Telecommunications and Vodafone, due for launch mid-year.

Output from the company's manufacturing plant at Broadmeadows in Melbourne would be stepped up this year and a further \$25 million spent to upgrade it, Lynch said.

Looking beyond the five years of the FMO switching contract, Lynch said Ericsson was poised to keep pace with the accelerated introduction of newer broadband technologies, and would even challenge NorTel in the area of intelligent network products. "We're across the entire spectrum, from the superhighways to all the other technologies required to keep Telecom competitive. World best practice also means moving into the international market and to our benefit, we're as pushy as Telstra when it comes to chasing new business opportunities. Frank Blount wants Telstra to generate \$1.5-2 billion a year in exports within five years and we want to be proactive in that, rather than sit back and wait to be called."

Alcatel's Chairman and Managing Director, Bill Page-Hanify, described the company's \$1.1 billion FMO contract as "a good number" that was close to the company's tender estimates. Despite Ericsson's dominance in GSM, the companies were still "neck and neck," Page-Hanify said.

The System 12/RIM contract would mean taking on another 100 engineers —

bringing the number to 400 — of a total extra 200 staff for the company as a whole. The contract also secured the ongoing employment of the 600 staff at the company's \$100 million manufacturing plant at Liverpool near Sydney. Production would immediately be ramped up for first FMO deliveries by July 1.

"We are very comfortable with Telecom's decision on switching. Whatever our rivals say about System 12, in dollar terms our sales will not diminish over the next few years. We've accumulated a lot of small business that contributes to our \$650 million annual turnover, and as long as we can keep the right spread and remain in our core business of switching, we'll continue to prosper."

Commenting on Alcatel's losses on the transmission and GSM fronts, Page-Hanify said: "All that happened in GSM is that Telecom has now standardised on Ericsson, which leaves us with the same opportunities everyone has of selling more radio gear. Our gear is out there working, hooked into Ericsson switches, which may even be a sensible standardisation. But we are still supplying base stations and we're ready to respond to any movements in the SDH transmission market."

Siemens spokesman, Geoff Fagan, said his company expected to quickly hire 100 new staff for its five manufacturing plants in Melbourne, Sydney and Brisbane as a direct result of its \$500 million five-year contract with Telecom. The new contract is to supply synchronous digital hierarchy (SDH) hardware and software modules operating at between 565Mbps and 2.5Gbps which will link all local exchanges and long-distance exchange clusters. A further 300 existing jobs had also been assured by the FMO contract, Fagan said.

"The real nub of the contract is that it goes beyond the simple buyer-seller relationship. In the past, suppliers would respond to a plan drawn up independently by Telecom. To some degree, there was a brick wall. But this tended to limit Telecom's ability to compete. Now, we can both get involved in the planning of the chips and bits and share the fruits of R&D work."

"Siemens will be able to deliver earlier if we're involved in their marketing and installation plans. Just as Telecom's engineers will have to learn about our operations, we are going to have to learn how to do business this way. There are no secrets any longer. They'll be part of our planning and we'll be a part of theirs. There'll be benchmarks for price, performance and delivery dates and we will work together to improve those in comparison with other countries."

Fagan accepted that there were always potential risks when a customer had a single supplier. But he said Telecom had clearly decided that the benefits were substantial enough to outweigh any potential down-

side. "A mixed-brand transmission system is a complex beast to configure and manage," Fagan said. "Our SDH network management system focuses on the hierarchy and makes it much more competitive for any PTT to deploy and control."

Other Opportunities

NorTel Account Vice President, Graeme Barty, refuted media reports that his company was the big loser in the FMO contracts. However, he conceded that NorTel would have liked to take some business from Ericsson or Alcatel but had done the full circle and ended up no better off as a result of its FMO bid. "We expect some growth in our revenues this year, but it won't be as significant as it would have if we'd become a mass switching supplier," Barty said. "But in the long term, there may well be a greater role for intelligent network-based services for both the business and residential environments than is currently envisaged. NorTel is actively investigating this potential. Telecom was able to put a raw figure on its local access network upgrade, but the size of any contracts for intelligent networks will depend entirely on how the market grows."

Barty said there was some consolation for NorTel in its 1991 contract with Telecom for \$270 million worth of intelligent network equipment and software over five years, and its export efforts with local manufacturer, Exicom. He also pointed to the lucrative prospects for NorTel in the provision of networks for State Governments and their agencies and large corporations, quite separate from NorTel's commercial relationship with Telecom.

Describing DMS-based networks as a world benchmark, Barty said NorTel had retained its R&D activities in Australia, largely through a 35-member team working on Bell Northern Research projects at Wollongong University, and was developing a new architecture to make the DMS's 25 million lines of code operate even faster.

General Manager of NEC Australia's Telecommunications Division, Brendan McManus, was philosophical about Telecom's decision to give Siemens the sole SDH contract. "Over the years, we've won more contracts than we've lost and there are plenty more out there that are equal to or greater in value that we will continue to pursue," he said. "We have ongoing deals with Telecom and Defence and our exports are strong. We're a sub-contractor to Olex cables in China and we have a strong PABX business in Papua New Guinea, New Zealand and Fiji." McManus added that NEC was fortunate not to be a single-product company and was developing new technologies to prepare for the era of asymmetric digital subscriber line services.

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said his company was surprised and disappointed that Telecom decided on only one SDH supplier. But he said that in the context of the commercial pressures of competing with Optus and achieving world best practice and value, Telecom's decision was understandable.

Adams said Philips was strong in transmission and video — particularly interactive video — and would use the experience

of losing out in the FMO tender to try to gain a foothold in Telecom's cable TV network. Philips was heavily involved with Telstra in exporting rural microwave systems and would also be heavily promoting its line of DECT cordless telephones.

"We have a very competent team in Australia after four years and we will expand into other markets. We're particularly conscious of deregulation coming up in 1997.

"We are a company that accepts the umpire's decision without question. But we are occasionally concerned when the game changes or the goal posts move. A tender is such a formal situation that you have to structure your business case on a realistic basis, as you considered it to be at the time. But if the game changes halfway through, it becomes more tricky."

Bernard Levy

The Health Network

A Plague of Privacy and Security Issues

Issues of privacy and the security of sensitive information look set to plague the proposed Australian Health Communications Network (HCN) long after its formal establishment some time in the first half of this year. Designed to hook up the nation's entire health care industry, the network will embrace 700 public hospitals, 320 private hospitals, 1,400 nursing homes, 460 community health centres, 5,600 pharmacies, 400 private and 120 public pathology laboratories, 22,400 allied health practitioners, 12,500 medical specialists, 23,000 general practitioners and 110,000 nurses.

Collectively the Australian health industry is estimated to be worth \$33 billion a year. The cost of running the HCN would be \$1.5 billion, or some 5% of the total, according to government consultants.

Administered by a team of about five staff within the Department of Health, Housing and Community Services, the HCN project has been funded to the tune of \$7 million over the past two years, most of the money going on pilot projects linking doctors and institutions in NSW and South Australia, and a national trial involving the Public Health Association of Australia.

The plan is for the HCN to be functioning by March-April and later to be incorporated as a private organisation with an interim board of around seven or eight to be appointed from industry and the medical profession. The rationale of senior Health Department advisers such as Dallas Ariotti, John Scott and Larry Cromwell is that the network should run like a business, funding its own growth by selling services. It will also act as a broker, negotiating cheaper, bulk-rate call charges for its subscribers.

The network's backers, including Joan Edgecombe from the Health Informatics Society of Australia see the HCN's horizons ultimately extending beyond Australia to New Zealand and South East Asia.

Scott said new funding arrangements would be made from June 30, when the \$7 million in joint State and Federal funding ran out, and contracts will be drawn up for

specific communications services. Hardly surprising, Telecom and others which have involved themselves in the pilots, are waiting in the wings for a slice of the commercial action. Telecom's Industry Marketer for the Health Sector, Marian Smedley, confirmed that the HCN, like the Australian Academic Research Network (AARNet) and others, was a potential market for Telecom's Fastpac metropolitan area network technology.

Confidentiality and Control

While the HCN's sponsors and supporters sing its praises in terms of the potential cost savings and greater speed and efficiency in transferring everything from x-rays, pathology and radiology results to medical records from one place to another, Australia's doctors are more concerned about confidentiality of patient information, and maintaining control of their own industry's communications network.

With some 20 million patient records to be computerised, the Australian Medical Association and its activist arm, the Australian Doctors Fund (ADF), has expressed grave concerns about the planning of the HCN and the lack of consultation with the medical profession. The spectre of the abandoned Australia Card has frequently been raised, along with the huge potential for security breaches. The ADF's Executive Director Steve Milgate said another spin-off of the privacy issue was that if patients felt their privacy was in danger, they tended to either give invalid information, or none at all. Somewhat ironically, Marian Smedley said one of the benefits of taking part in the pilot projects and tackling the privacy issue, was that Telecom had improved the security encryption systems of some of its services, including facsimile.

According to Steve Davies, a Director of Privacy International and consultant to the British Medical Association, who recently reviewed the HCN proposal for the AMA: "If any such system were to be contemplated, then a Senate Committee should be established for the express purpose of fully investigating all the ramifications of a Universal Health Computer System. Privacy, civil liberties and AIDS organisations have also expressed concern and the British Medical Association has also voiced opposition to a similar plan in the UK."

Davies said that while there would be no single central database for the network, a distributed system would provide the same features as a central storage and recovery system which would contain complete medical histories and profiles.

If the plan proceeded to the development of a smart card, Davies said, the data on the cards would have to be backed up by a series of data repositories and any additional security information held on the card itself would be well and truly outweighed by the added vulnerability of the personal information held elsewhere on the system.

Davies also made the point that because the project is envisaged as a private sector venture, it would not be covered by privacy law. "Despite claims by the planners of the HCN that their system will be secure from unauthorised access or hacking, there is a likelihood that such violations will occur. The revelations of the Independent Commission Against Corruption in 1992 showed that corruption among information users inside and outside the Government had become endemic and epidemic," Davies said.

Head of the Privacy Branch of the Human Rights and Equal Opportunity Commission, Nigel Waters, said the 1988 *Privacy Act* established 11 Information Privacy Principles (IPPs), which governed the collection, storage, quality, use and disclosure of personal information. But Waters noted: "It is unlikely that the *Privacy Act* will apply to the HCN body itself because they apply only to Federal and ACT Government departments and agencies." While it was proposed that the HCN agency be classified as a service provider under the *Telecommunications Act*, meaning that it could fall within the sphere of the Telecommunications Industry Ombudsman, the TIO would be unable to investigate breaches of privacy standards by HCN users.

Director of the HCN Project, Tony Mair, said the privacy issue had to be treated service by service. "Some services like patient medical information and records have a far higher privacy concern factor than others like drug or poison information or education-type services," he said.

"Obviously, we're very concerned to establish a satisfactory privacy framework, otherwise the health sector won't get involved or feel comfortable."

Bernard Levy

Australian Industry

NetComm, Scitec Go Shopping For Money

The recent successful fund-raising exercises by Australian communications equipment manufacturers, NetComm and Scitec owe as much to the heightened interest in telecommunications stocks as they do to the quality of the respective companies' product lines.

At NetComm, which has laboured under five years of debt from the 1980s, partners Chris Howells and Luke Conte have sold down their 100% stake to just 27%, divided evenly, relinquishing 73% in a listing on the Australian Stock Exchange designed to raise around \$9 million at \$1.10 per share. Howells remains Managing Director while Conte becomes Technical Director.

At Scitec, which has been carrying \$8 million in bank debts, a renounceable rights issue to shareholders has helped the company raise just over \$6 million, \$1.3 million of which will be used to retire debt and the remainder used as working capital.

The operating funds are needed for the production of the company's new packet-based network management system, FastLane. Scitec Managing Director, Hartmut Boedefeld, said the product was already in strong demand and would lift the company's fortunes this year and next after a \$17.8 million loss in the first half of 1992-93, and a modest \$500,000 profit in the second half.

FastLane orders had been signed with the San Miguel brewery in The Philippines and beta tests in Australia had brought extremely positive reactions. "Wherever we

demonstrate the F3 and the F5 models, they love it," Boedefeld said. "The beauty is that you can piggy back them if you need more ports or trunks, and the price is right." Through voice compression, voice/data integration and bandwidth management, FastLane offers savings to small to medium sized companies which were previously available only to large corporations.

Based on FastLane's expected success, Scitec has set a modest target for 1993-94, but expects to have a "buoyant" balance sheet by the following year, with a 5% return on sales and a 20% return on equity.

Analyst with Hambros Telecommunications, Dr Chris Beare, said both NetComm and Scitec had very likely benefited from a heightened interest in telecommunications stocks caused in part by Optus' arrival on the local scene.

"For many years, overseas analysts have had a greater understanding of the telecommunications market and investment has been very active in places like the UK and the US. That's just starting to happen in Australia, but investment by foreigners is limited by the small number of generic companies operating here.

"Optus has influenced the way analysts are thinking about the telecommunications scene and who is supplying these industries. It is not a huge wave, nothing terribly dramatic, more a natural evolution that will continue."

A spokesperson for SBC Dominguez Barry, which handled the NetComm float, confirmed strong interest from institutional investors like the large insurance companies, superannuation funds and what he described as "a whole school of companies which follow the smaller, promising Australian companies." Asked whether there had been much foreign interest, the spokes-

man said there was possibly a small percentage of Asian investment, but this would have been through Australian nominees.

The NetComm float also brings on board three well-known figures in the telecoms industry: George Maltby, former CEO of OTC, as Chairman; Terry Winters, who spearheaded Optus' victory for the second carrier licence; and Robert Inglis, who was formerly on the board of Stanilite Pacific and who has a high profile in the finance community.

"We had to convince the sharemarket that the company's management was committed to change. Bringing in people like George Maltby certainly sent the right message," said Howells. "George has excellent contacts in Australia and overseas, particularly in Asia where he's on first-name terms with large companies and the heads of the PTTs."

Howells said he had no regrets at selling down his stake, saying he was greatly relieved that the company was now out of debt. After revenues of \$29 million for 1992-93, Howells projected a turnover for 1993-94 of around \$31 million, with an operating profit after tax of just over \$1 million. Howells said the company had solid prospects with its range of smart modems and auto-modem devices and was poised to take the next step into voice processing and the digital markets.

Now debt-free, NetComm will keep a close eye on its staff level of 125, most of them based at the company's Sydney headquarters. Howells said greater enthusiasm had been generated during the float when 100,000 shares and 350,000 options were offered to staff. "For those who bought in, it's a case of participating in the company's capital growth and profitability," he said.

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Asia

The Asian Investment Boom

Talk to anyone in the Australian telecommunications industry about exports and the chances are they will talk about Asia. The nations to Australia's north and north west are seen as lands of opportunity for local telecommunications manufacturers, carriers and service providers expanding their horizons beyond Australia's shores.

Anyone seriously interested in Asian markets would have found plenty of grist for their mill at a three day conference held in Bangkok, in December. Organised by IIR, the third annual Pan-Asian Summit provided updates on current regulation in a number of the most important Asian markets, and other speakers reflected on the global forces shaping the industry.

Collectively the multinational corporations (MNCs) form one of the most powerful of these global forces and at least two speakers chose to focus on how these are shaping telecommunications development.

Ken Zita, a partner with Network Dynamics Associates of New York, argued that national carriers would have to develop coherent plans to support the emerging sophisticated global networks of the MNCs, regardless of the level of development in their networks overall. He described the MNCs as "financially strategic and strategically troublesome (for PTTS)," challenging the company culture. The importance of the MNCs as a factor in Asian regional telecommunications development was reinforced by Doyle Girouard, Vice President Marketing, Sales and Product Management with AT&T Submarine Systems Inc.

Girouard said there were some 37,000 MNCs with 170,000 affiliates outside their home countries and that they controlled 33% of the world's productive assets.

Competing For Funds

Many Asian nations now recognise that they cannot fund network expansion and upgrades without foreign investment, but the difficulty is in gaining that investment without losing control of their networks completely. Compounding the problem is the increasing competition within the region for available investment capital.

Andrew Harrington, a stockmarket analyst with Salomon Brothers Hong Kong, catalogued the rapid increase in regional opportunities for investors wanting to put their money into telecommunications. He named four carriers as the only listed telecommunications companies in the Asia-Pacific in 1990: The Philippines Long Distance Telephone Company, Hongkong Telecom, NTT and KDD. These, he said, had a total

free market value of \$US45 billion. By the end of 1993 this number had grown to 10 with a free market value of \$US75 billion. A further four second carrier networks and four cellular operators had also been listed, taking the total value of the free market to \$US85 billion. He predicted that between 10 and 20 more could be listed by 1998 (including Telstra and Optus) taking the total issued equity to between \$US150-\$US170 billion.

At the same time the flow of investment by specialist telecoms companies into Asia has increased dramatically. Harrington put the current figure at about \$US12 billion, double the 1990 figure, and he estimated the 1998 figure could be three times the 1990 figure. He contended that what investors wanted was an industry that was like any other: i.e. open to competition and free from excessive government control.

His conclusions are particularly important to what is seen as the largest potential market in the region, China. The Chinese Government in his estimation, had six months to get serious about foreign investment before potential investors put their money into more attractive opportunities such as India, Indochina and South America.

It became clear from other speakers that some of these markets are much more committed to permitting foreign investment than China which maintains an official policy of prohibiting foreign investment in its telecommunications services. Certain local projects which seem to breach this policy are, however, allowed to go ahead and China watchers analyse each new development with keen interest as an indicator of the real direction of policy.

After China, India is seen as the second largest market and there are signs that the Indian Government is rather more welcoming to foreign investment. A distinct change occurred last October with the appointment of the pro-liberalisation Mr N. Vittal as Minister for Communications.

Late last year the Government announced a guaranteed rate of return of 18% for foreign investors putting money into Indian telecommunications networks. However, mixed signals are still coming from that nation and shortly before Christmas plans for privatisation of the network were put on hold when unions representing telecommunications workers threatened strike action.

An impassioned sales pitch in favour of India and aimed at potential telecommunications investors was delivered by Dr Chiranjeev Kathuria, a Chicago-based investment manager who also revealed that Telecom New Zealand is poised to be one of the first foreign carriers to take a major stake in Indian Telecommunications services.

In a joint press conference in New Delhi, Telecom NZ and Indian telecommunications manufacturer Bharti Telecom announced a proposal to set up a joint venture in Punjab State to provide telecommunica-

tions services using wireless technology as an overlay to the fixed network.

Telecom NZ would hold 40-50% of the venture, Bharti Telecom 30-40%, a Punjab State Government body would hold a small share and overseas investors, would hold about 10% through a fund managed by Kathuria. In addition to the public network, estimated investment of 500 million rupees (\$23 million) the venture was also negotiating to provide a network for the State Government at a cost of 1,000 million rupees.

However at the time of writing the situation is unclear. A joint venture between the Deutsche Bundespost Telecom and Fujitsu is also reported to be negotiating with the Punjab Government for the business.

Kathuria said India has the third largest economy in Asia, the fifth largest in the world and unlike most of its neighbours has no shortage of skilled technical talent.

India presently has 17,000 telephone exchanges and 6.9 million lines, making it the 19th largest network in the world. The Government plans to increase the number to 20 million by the end of the decade but there are serious doubts that it can achieve this without foreign funding. Demand for new services is enormous, the waiting list in Bombay alone is 230,000 and New Delhi 380,000.

Similar situations of massive unmet demand were described in the Philippines by the new head of the National Telecommunications Commission, Simeon Kintanar. The solution adopted there, according to Kintanar makes the Philippines "the most deregulated telecommunications environment in the world." The Government has opened the lucrative cellular mobile and international telecommunications markets to competition but has required entrants to also provide a substantial number of fixed services.

Are We in the Race?

Australia is doing well in a number of Asian markets but will have to work hard if the Government-proclaimed goal of exports worth \$2 billion annually is to be achieved by 1997. Figures compiled by AEEMA show the 1993 figure to be about \$550 million, 52% up on 1992's \$360 million. An annual growth rate of around 40% will have to be sustained to reach the \$2 billion target. Meanwhile much more powerful organisations are targeting Asia.

AT&T, for example, which is trying to gain half its sales from outside the US by the year 2000, has offered the Indian Government a \$US1 billion package which proposes vastly expanding India's basic telecommunications services and promises to eliminate the country's huge waiting list for telephone services within two years. That sort of offer will be hard to beat.

Stuart Corner is the Editor of Exchange.

SNA Over TCP/IP? Try Tn3270

Instead of blowing the budget on new bridges and routers, organisations should try Tn3270 for handling SNA traffic over TCP/IP backbones.

Corporate networkers have spent the better part of the past few years searching for a quick and painless way to merge IBM terminal-to-host traffic onto TCP/IP-based LAN internetworks. Rather than looking ahead to the latest and greatest (and priciest) technologies, net managers could have saved themselves lots of time and money by deploying a networking protocol developed years ago to link dumb terminals to hosts over TCP/IP. That protocol is Tn3270.

Tn3270 lets ASCII terminals or PCs emulating IBM 3270 terminals use a TCP/IP backbone to reach the mainframe. All that's needed is some software that runs on client and host machines. With this software, organisations can bring SNA traffic onto the TCP/IP internetwork without having to invest in new SNA-capable multiprotocol routers or LAN gateways. And because it runs over internetworking gear already in place, the Tn3270 approach is more reliable than installing new equipment.

Tn3270 isn't so much an industry secret as it is a forgotten technology. It actually is part of the TCP/IP protocol suite and was developed by university researchers who needed a way to access IBM hosts from their asynchronous DEC VT100 terminals. Over the years, Tn3270 has been shunted aside as users and vendors focused on more leading-edge aspects of TCP/IP.

The protocol is now making a technology comeback, as more commercial users turn to it as a cost-effective alternative to SNA internetworking gear. The Internet Engineering Task Force (IETF) has renewed its efforts to expand Tn3270 and make it a formal standard, a task that has the backing of a growing number of internetworking vendors.

The most compelling reason to consider Tn3270 for merging host-based traffic onto TCP/IP internetworks is its low cost. The protocol can help network managers save money in a number of ways. Among them:

- Remote users can gain dial-in access to LAN servers and host machines through the same hardware.
- Tn3270 lets organisations use twisted-pair wiring to give central PCs access not only to LAN servers but also IBM hosts. Straight 3270 terminal emulation requires the installation of coaxial cabling as well as 3270 emulation boards.
- Network changes are easier to make and less costly. With terminal-to-host net-

works, address tables stored at the host have to be reconfigured every time a user terminal is added or changed. With Tn3270, access is over the LAN; user location is not an issue for the host.

- TCP/IP routers already in place can handle all internetworking traffic, eliminating the need to install new equipment.

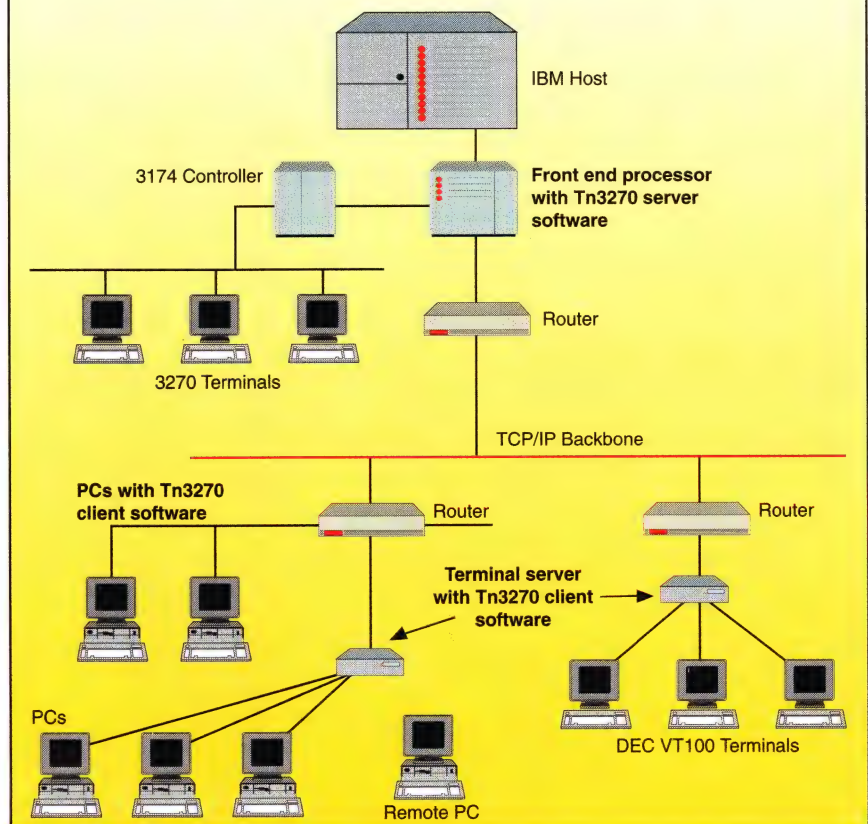
Tn3270 does have drawbacks that do need to be considered. The original spec, which hasn't been formally changed, has several gaps that have been filled in different ways by different vendors. Although many interoperability bugs have been worked out, the lack of standardisation means Tn3270-compliant software from different vendors does not necessarily work together. The hope is that the new IETF standardisation effort will furnish a more complete specification that will ensure software interoperability.

A second weakness has to do with the way that 3270 terminal emulation works in general. Some keys that are present on a 3270 terminal keyboard don't exist on PCs or other terminals; to activate the functions controlled by those keys, users must type keystroke combinations that are sometimes awkward. Because of this, Tn3270 isn't well suited to handling heavy-duty terminal-to-host traffic. But for LAN users who need relatively sporadic access to mainframes for such tasks as database lookups or e-mail downloading, Tn3270 fits the bill.

Tn3270 uses protocol encapsulation to send IBM 3270 data between an end node and a host. The traffic is sent over the backbone in TCP/IP Telnet packets. Encapsulation and de-encapsulation are handled by server and client software at either side of the link (see Figure 1).

Figure 1: A Terminal Path Over TCP/IP

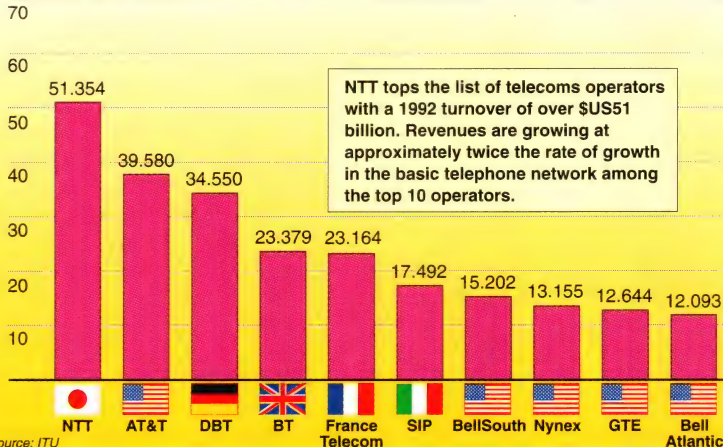
Tn3270 software enables IBM 3270 terminal-to-host traffic to be carried over a TCP/IP backbone without the need for special SNA-capable routers or LAN gateways. Client software encapsulates 3270 traffic in Telnet packets for transmission to the host.



Market Watch

Top 10 Public Telecoms Operators, 1992

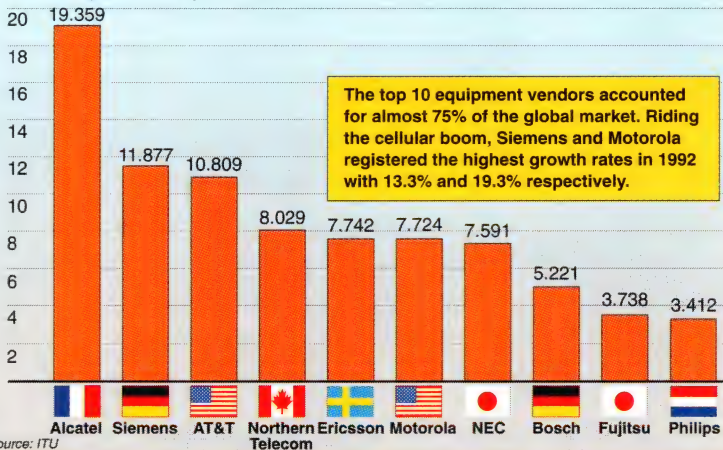
Revenue (\$US Billions)



NTT tops the list of telecoms operators with a 1992 turnover of over \$US51 billion. Revenues are growing at approximately twice the rate of growth in the basic telephone network among the top 10 operators.

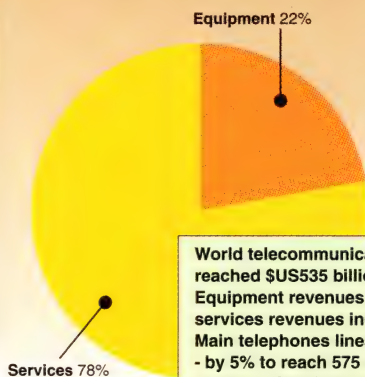
Top 10 Telecoms Equipment Manufacturers, 1992

Revenue (\$US Billions)

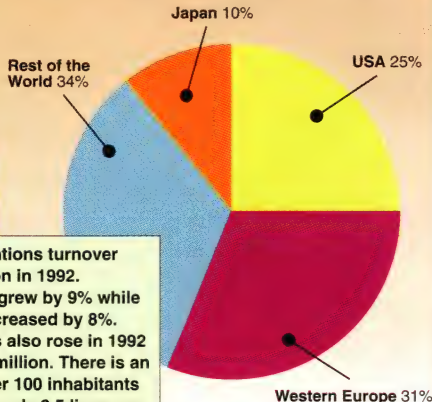


The top 10 equipment vendors accounted for almost 75% of the global market. Riding the cellular boom, Siemens and Motorola registered the highest growth rates in 1992 with 13.3% and 19.3% respectively.

Telecoms Turnover, 1992



Main Telephone Line Distribution, 1992



World telecommunications turnover reached \$US535 billion in 1992. Equipment revenues grew by 9% while services revenues increased by 8%. Main telephone lines also rose in 1992 - by 5% to reach 575 million. There is an average of 49 lines per 100 inhabitants in OECD nations, but only 3.5 lines per 100 inhabitants in the rest of the world.

Source: ITU

Terminal Conversion

Tn3270 emulation software converts terminal data from the host for display on the user's screen (a PC, Macintosh, or VT100 terminal) and converts keystrokes from the user into data the IBM host will understand. These functions are the same as those performed by any of the emulation software, such as 3270 software used with coax boards or LAN gateways. Tn3270 emulation software differs from other types of 3270 emulation products in that after it has performed the requisite conversions, it puts the data into TCP/IP Telnet packets for transmission over the TCP/IP network. Other types of emulation software would send the data either to a coax board or to a gateway using SNA or LAN protocols such as NetBIOS or IPX.

Tn3270 server software can run directly on the host or a front-end processor (FEP). Several vendors, including IBM, offer TCP/IP packages for IBM hosts that provide the Tn3270 server function. FEPs used as Tn3270 servers typically are channel-attached gateways, such as the IBM 3172 Interconnect Controller or the McData 6100 from McData Corporation. Other companies that sell Tn3270 software for FEPs include Intel and NCR.

Whether it runs on a host or FEP, the basic job of Tn3270 server software is to serve as a 'bridge' between the TCP/IP network and host applications that communicate with 3270 devices. As the bridge, the Tn3270 server establishes, maintains, and terminates sessions between terminals and the host, as well as forwarding the 3270 data stream from the host to and from the Tn3270 client via Telnet.

On the client side, Tn3270 software can run on individual PCs, terminal servers connected to several PCs or terminals, or a FEP connected to the host. Software for individual DOS or Mac clients is available from Attachmate, FTP Software, Intercon Systems and Walker Richer and Quinn. Vendors that sell Tn3270 software for terminal servers include Datability and Xyplex.

Placement Concerns

Placement of client software has a big effect on the performance and manageability of Tn3270 schemes. FEP-based client software performs all the necessary conversions on behalf of terminals or PCs emulating terminals, which are connected to the network via a terminal server or a Unix host (see Figure 2A on page 44). The front-end processor running the client may be channel-attached to the mainframe, or it can act as a remote concentration point communicating with another front-end processor at the mainframe site via SNA or X.25 links.

When Tn3270 client software runs in FEPs, performance can suffer for a number

Continued on page 42

Multimedia

PSTN Desktop Conferencing Near

Announcements trumpeting great 'break-throughs' in 'multimedia conferencing' and the like are usually received by the technical press with the cynicism their frequency of arrival warrants. Occasionally, however, a product does come along which leaves even the most hardened cynic more than interested — if not yet entirely convinced.

Tryst, a new conferencing product jointly developed by Melbourne-based Creative Software Technologies, falls into this category. This small Australian software company has gone into an association with Telecom Australia subsidiary Advanced Network Management, and two US companies; Compunetix, which makes videoconferencing switches; and Comtech Labs, which specialises in codecs with video and audio compression. Between them, they are planning to introduce a Multipoint Multimedia Conferencing service which may just work.

For its part, Telecom will create a switching centre (called an MCU — Multipoint Control Unit) in its network using Compunetix's new 'space-division switch.' (As far as I can tell, space-division switches were invented by Strowger in 1892 so let's not get excited by the choice of terminology.) This space-division switch appears to be a circuit-switching unit with multipoint possibilities, so I can dial into the MCU in Telecom's network, and make connection to a number of other conference attendees.

Space-division refers to switch being a multipoint cross-connect using physically distinct and identifiable paths across the cross-points; as distinct from most cross-connects which use a time-division approach. By avoiding time-division across the switch, they then aren't limited to a fixed bandwidth and channelisation.

What Compunetix seems to have created is a non-blocking cross connect device that they've called Orchestrator. In effect, this is an automatic version of the old manual exchange patch-panel, but with the ability to make multipoint connections. The company claims that Orchestrator can handle 1,024 simultaneous connections, and has three 50-page patent documents to prove its point.

Telecom will also provide translation services on the various input ports of its MCU, so someone entering the switch via a PSTN line using one video coding standard should be able to connect to another using ISDN channels and another proprietary standard — and they should both be able to talk to a third party (or more) using, say, a full 128Kbps connection and the H.261 videoconferencing standard.

Technology Update

■ Multimedia MIB in Development

The Multimedia Communications Forum (MMCF) has already started work on a multimedia MIB (management information base), in preparation for the expected arrival of a surge of multimedia applications. The MM/MIB will define a uniform set of management attributes for real-time interactive multimedia services over both local and wide area networks, including ATM, FDDI, ISDN and Isochronous Ethernet (also known as Iso-Enet). The MIB is expected to comply with both SNMP and CMIP (common management information protocol). AT&T, IBM, Ericsson and California-based Luxcom are helping to assemble the MIB, which is due for its first demonstration in midway through this year.

■ OSF Dumps Key DME Element

The latest in the long and troubled saga of the Open Software Foundation's Distributed Management Environment (DME) is the decision by the Foundation to eliminate the object request broker (ORB) from the DME proposal. The DME is a planned suite of integrated management tools for the Foundation's Distributed Computing Environment (DCE). The ORB was a key element of the DME proposal, and was to have acted as a management information 'traffic cop.' In the original plans, the role of the ORB was to recognise and direct requests for management information from various protocols including SNMP, CMIP, and RPCs (remote procedure calls). Instead of the ORB, the DME will now feature APIs that developers will be able to use to write their own ORBs. Some commentators have speculated that this latest move will herald the death knell for DME, which has been plagued by missed delivery dates and unsuccessful ORB specifications.

■ Novell to Licence Intel Video Technology

Novell has signed a deal with Intel Corporation to licence that company's Indeo video technology for incorporation in Novell's new NetWare Video software. Novell claims NetWare Video will dramatically improve the ability of standard 10Mbps Ethernet and Token Ring NetWare networks to manage the storage, delivery and playback of video files. Features include support for multi-server environments, simultaneous delivery of video files to multiple PC nodes, and automatic network video traffic balancing. The Intel Indeo technology allows for software-only video playback on Intel 486 and Pentium processor-based PCs, eliminating the need for add-on hardware to play back video files.

■ IBM/ADI ICs to Boost Wireless Technology

IBM has signed an agreement with Analog Devices (ADI) to jointly design, produce and market new mixed-signal integrated circuits (ICs) based on IBM's ultra-high-vacuum chemical vapour deposition (UHV/CVD) silicon-germanium (SiGe) process. The SiGe process enables the production of silicon transistors that operate at speeds of over 60GHz. The chips are able to operate at 3-volts and 1.5-volts, which significantly reduces the amount of battery power required and makes the new chips particularly well-suited for incorporation into light, low-cost wireless systems. The process can also be integrated with digital CMOS into Bi-CMOS, opening the way for single-chip digital telephones. ADI will soon introduce a family of radio frequency and mixed signal circuits for wireless comms based on the SiGe process.

■ Interest in Fast Ethernet Hots Up

Excitement over the potential of fast Ethernet technology is growing, with a flurry of vendors and industry groups currently hopping onto one or other bandwagon. Full duplex Ethernet, a proprietary technique which supposedly doubles the throughput of Ethernet networks, has received a boost after Cabletron announced it will feature full-duplex Ethernet technology in its new ESXMIM switching module for its MMAC modular hub, due this month. Full duplex adaptors have also been announced by a range of vendors, and are already available from Compaq and IBM. Meanwhile, the IEEE 802.3 CSMA/CD working group has established a 100Base-T task force to scale the widely used 10Base-T Ethernet standard from 10Mbps to 100Mbps. The task force has selected two complementary transmission methods to cover a broad range of user requirements for cable type, including two-pair Category 5 UTP, STP, fibre optic and four-pair Category 3, 4 and 5 UTP. In another move, SynOptics and Intel have recently signed an agreement to jointly market interoperable 10/100Mbps Ethernet products.

■ Sun Standardises for Strategic Gain

A report by the US standards body ANSI claims that Sun Microsystems is one of America's top four industrial corporations to use standardisation to gain strategic advantage. The study examined over 100 major US corporations, but Sun was the only computer company to reach the top ranking. A spokesperson for Sun said the company has founded its business on standards such as Unix and Ethernet, and has also had a hand in the development of such standards as XPG 3, XPG 4, various versions of POSIX 1003, and the 'unified Unix' spec known as Spec 1170 which is standardising Unix APIs.

This is where Comtech Labs comes in. It's offering a 'high resolution, full colour motion video codec' capable of running over normal POTS telephone lines. 'High resolution' here should be read as a separate attribute to claimed 'full colour motion video' — and 'full' is separated by one word from 'motion,' you will notice. No one is pretending that you are going to get HDTV over the standard analogue phone network, but the combination of words looks good in the brochure copy.

At this low end of the scale, with a single POTS connection, you will see a low-quality and occasionally-moving image of the speaker, plus compressed sound, and it will all be running over a good fast modem. The most useful part of the image feature at these data-rates, however, will be to send and receive data between PCs — to use the PC, in effect, as an electronic whiteboard.

"We digitise voice and video, and take digital data from a PC application, then multiplex the lot and shoot it down a single channel," Mike Dewhirst, Business Development Manager at Creative Software Technologies explains. "We have four virtual channels within a single stream: video, voice [to which between 2.4 and 9.6Kbps is allocated] and data, and we add a control channel which is used to send commands to the MCU [with multipoint], and to the terminal at the other end in a point-to-point connection."

"The video-rate is variable and it occupies whatever bandwidth remains after voice and control channels have been allocated. When sending data, we can throttle back the data-channel so that it runs slowly thus maximising the bandwidth available to the video — or we can send it flat-chat and freeze the video," he says.

Where Creative Software come into this picture is in providing the control systems that coordinate the hardware and software functions. It has written the software for the desktop PCs and for the Compunetix MCUs and the first Tryst products will reach the marketplace this year. Currently, software is only available for Windows-based PCs, but Macintosh, X-Windows and Unix GUIs are in the pipeline.

Creative has chosen to use a form of in-band (but dedicated channel) signalling based on the H.233 standard, rather than rely on ISDN's D-channel signalling, because the same control system is then available over all types of access links. On POTS lines the service works down to data-rates of 9.6Kbps in total, so you may not even need to buy a new modem.

"In one mode, you can click on a screen icon of a person in the conference and see that person, so you can select the video yourself," Dewhirst says. The video switching can be controlled either by the user, or by the chairperson of a multipoint conference. Audio is summed and broadcast to all.

In point-to-point connections the control signals pass through the MCU, directly to the end terminal. "I can open up a whiteboard on your machine, and show you, say, the press release we sent out, and we could then discuss it," he explains. "You could circle things using paint-brush-like tools. You can cut and paste from your clipboard to mine, and vice versa; and in fact, I can run a whole slide-show seminar, using Harvard Graphics or Powerpoint."

Similar presentations can be made in the multipoint mode and, during the presentation, a document could be shipped to all conference attendees. "At my choice, this document could go straight to your printer, or be left for you to collect as a file," Dewhirst explains.

They are aiming for more than just videoconferencing with this new network service. Dewhirst lists workplace deployment (send staff home and use this service to keep in touch), video monitoring and security, image browsing, transmission and collection, as possible applications.

As I see it, this is the first possibly-viable attempt to use the PC and POTS lines for communications with this degree of multimedia flexibility. So Tryst and Orchestrator could be the beginnings of new Value Added Network Services which turn our existing copper network into something much more than just a telephone voice-call system.

Stewart Fist

Data Comm Lab Test

PC-Based Routers: Ready for Remote Sites

Network managers are a tough audience. Ask them about routers and they'll acknowledge high performance, reliability, and multiprotocol mastery in one breath, while blasting complexity, cost, proprietary technology, and configuration conundrums in the next. Ask them about PCs and you'll get equally mixed reviews: sure, they're cheap; open, and a snap to set up, but PCs are not the most-reliable technology going, and they're hard to manage remotely. So what happens when router meets PC? To hear the vendors tell it, the result is a combination of router intelligence and PC simplicity.

Network managers may greet that assertion with some scepticism. The Data Comm Test Lab certainly did. After all, we've been testing remote access products for nearly three years now, and we're used to seeing the best performance from equipment optimised for specific tasks.

PC-based products, in essence, consist of routing software that runs in a dedicated

PC or is slotted into a file server, along with the requisite WAN adaptor cards. To find out how well this gear stacks up against its proprietary counterparts, we put four PC-based routers from three vendors through more than 200 tests.

We're happy to report some very positive findings: the PC-based routers we looked at give nothing away to proprietary rivals when it comes to linking remote sites (their chief application). They have no trouble filling a high-speed line and can handle bursts with the best of them. The only significant shortcoming we found, in fact, was limited protocol support.

Two products were especially noteworthy. The LAN2LAN/Mega and LAN2LAN/MPR from Newport Systems Solutions stood out for high performance, support for transparent bridging, and data compression. The two other entries — the Multiprotocol Router Plus (MPR Plus) from Novell and the Routexpander/2 from IBM — do deliver something that the Newport boxes lack: source route bridging of Token Ring traffic. This is a key requirement for sites with unroutable NetBIOS or 3270 frames.

Picking Priorities

We judged PC-based products on five main criteria: architecture, protocol support, data compression, ease of setup and manage-

ment, and performance. Price, another factor on everyone's shopping list, turned out to be something of a disappointment. Although these products are generally less expensive than their remote router counterparts, putting together a top performer means buying the router software and WAN cards and shelling out for a fast PC with plenty of RAM.

Architecture, whether the product is destined for a file server or a standalone PC, is a critical concern since it will directly affect cost, ease of use, and performance. Protocol support was spotty, with most gear offering only two or three popular protocols and an incomplete set of bridging capabilities (see the table on page 32).

Data compression got the once-over because PC-based equipment is going to be teamed with expensive WAN links. Ease of setup and management is essential, since PC-based routers are generally intended for users who don't have the expertise (or the patience) to deal with problems. We put the greatest emphasis on performance, checking to see if PC-based routers could deliver throughput comparable to that of proprietary boxes and whether they could handle bursts at rates above that of the WAN link.

Along the way, we came up with an industry first: a multiprotocol router test that actually used multiprotocol traffic. Previous



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Test Methodology

The Data Comm Test Lab measured performance by sending traffic between pairs of PC-based remote routers over a simulated wide area link. Test traffic was generated on a LAN, sent between the routers over the simulated WAN, and measured on the receiving LAN. The routers were attached to an Ethernet or Token Ring LAN on one side and to a pair of AT&T Paradyne Data-phone II 700 multiplexers on the other. The multiplexers simulated WAN speeds of 56, 384, 768Kbps, and 1.536Mbps. The routers used EIA-232 connections to the LANs and V.35 connections to the muxes.

To generate test traffic, we used a DA-30 analyser from Wandel & Goltermann running W&G's Flexmit software. To measure received traffic, we used a Network Advisor analyser from Hewlett-Packard and a LAN-decoder analyser from Triticom. We checked the validity of received test traffic with a Sniffer analyser from Network General.

All the routers were configured as standalone devices for this test. The products intended to reside within file servers — LAN2LAN/Mega and MPR Plus — were configured with runtime versions of Netware Version 3.11. All routers that supported IPX were configured with Novell's LIPX.NLM driver, which enables routing of packets larger than 576 bytes.

At each speed, we sent 64, 512 and 1,518 byte packets for Ethernet; for Token Ring, we increased the maximum packet size to 4,096 bytes. Three types of traffic were sent: pure IP, pure IPX, and 50-50 mixture of the two. In all cases, we began sending test traffic at a level below the WAN speed and gradually increased the offered load until the routers started dropping packets. In addition to the throughput tests, we also measured file transfer times, using a NetWare 4.0 client and server across the LAN. Our test measured the time necessary to copy a 1Mbyte file from client to server over the WAN. Test results were similar for all products tested.

tests used multiple traffic types to clock router performance, but they sent only one protocol at a time over the link. Our evaluation shipped mixed streams of IP and IPX as well as single-protocol traffic, bringing us a big step closer to real-world conditions.

Generally speaking, we found that PC-based routers have what it takes to compete with standalone boxes — that is, they can handle steady-state traffic at similar speeds. That said, it's time for the industry to admit that the whole controversy surrounding remote router performance is more than a bit overblown. After all, a remote router needs to perform only as fast as the WAN link it works over (or perhaps slightly faster).

PC-based router architectures vary from vendor to vendor. All have the same basic components — DOS or OS/2 routing software and WAN interface cards for remote links — but the similarities end there.

Server-based products offer a price advantage since they don't require a separate PC to be purchased. But that saving must be traded off against performance. When installed within a server, a router must contend for PC resources, competing with other tasks such as file transfers, directory updates, network logins, and the like. This may not be a major problem, especially when price is the most important consideration, but it must be factored into any decision. All the gear we tested except Newport's LAN2LAN/MPR is intended for in-server use. (In every case, we evaluated products in dedicated PCs to ensure a fair comparison).

Whether implemented in a file server or a dedicated PC, the performance of a PC-based router also depends on the speed of the PC itself, especially when handling large quantities of small packets. Newport and Novell both supplied PCs with 66MHz

Intel 486 CPUs, and Novell further helped its cause by loading its PCs with 20Mbytes of RAM, giving its routing software plenty of room to run.

Given that the PC-based routers we tested handle only a few LAN protocols — IP, IPX, and (possibly) AppleTalk — lack of support was a very real issue. (Novell's entry also routes OSI). In contrast, low-end routers from vendors like Wellfleet Communications do much better, supporting Banyan Vines and DEC LAT as well as all the common LAN protocols.

Granted, limited support may not be much of an issue for some remote sites; after all, many satellite offices only run one or two protocols. Still, we'd prefer to see routers that can accommodate whatever protocols might be added in the future.

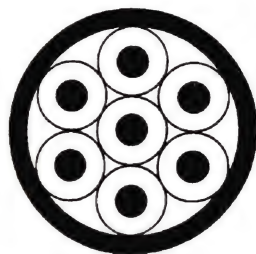
IBM's Routexpander/2 was noticeably lacking in this area: IP is the only LAN protocol it routes. When the Routexpander/2 first appeared early last year, IBM indicated it was working to add support for IPX and AppleTalk — an effort that apparently is still under way.

On the plus side, WAN protocols proved to be a big bonus for PC-based routers. All the routers tested support PPP (point-to-point protocol) a standard adopted by the IETF (Internet Engineering Task Force) as RFCs (requests for comment) 1171, 172, and 1331. PPP, as one of the few standardised WAN protocols, ensures compatibility among vendors' products.

Vendors that don't support PPP typically use proprietary versions of HDLC (high-level data link control), which rules out interoperability. Thanks to PPP, PC-based routers at remote sites can link to a backbone network built with high-end routers (provided, of course, that high-end equipment also supports PPP).

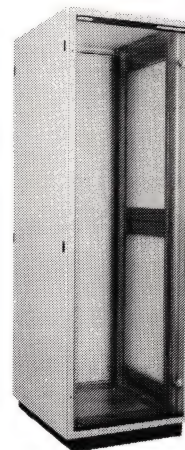
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Figure 1: IP Over Ethernet

Bandwidth Utilisation (Percent)

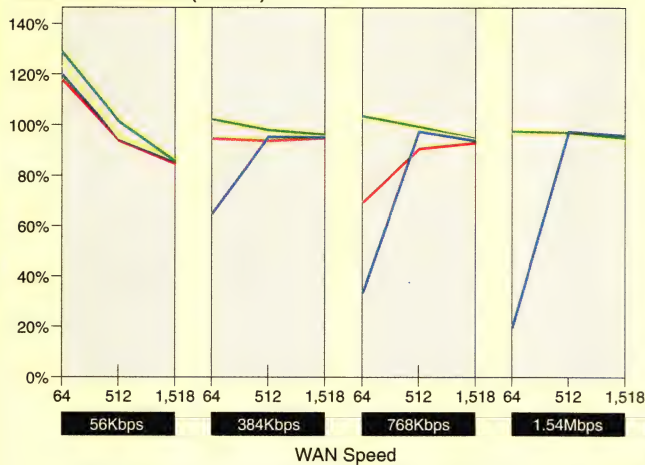


Figure 2: IPX Over Ethernet

Bandwidth Utilisation (Percent)

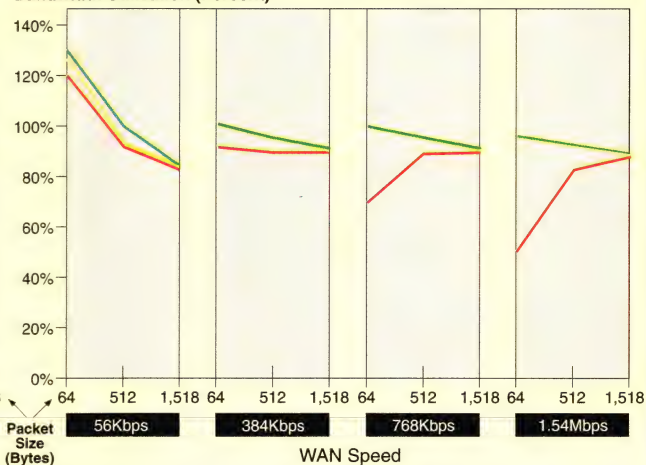


Figure 3: IP and IPX Over Ethernet

Bandwidth Utilisation (Percent)

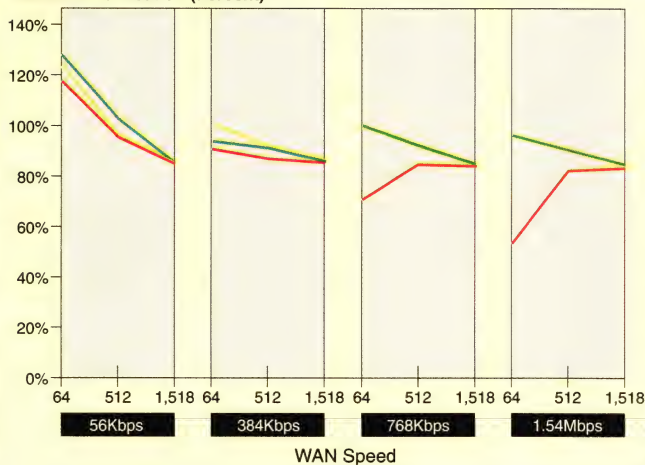


Figure 4: IP Over Token Ring¹

Bandwidth Utilisation (Percent)

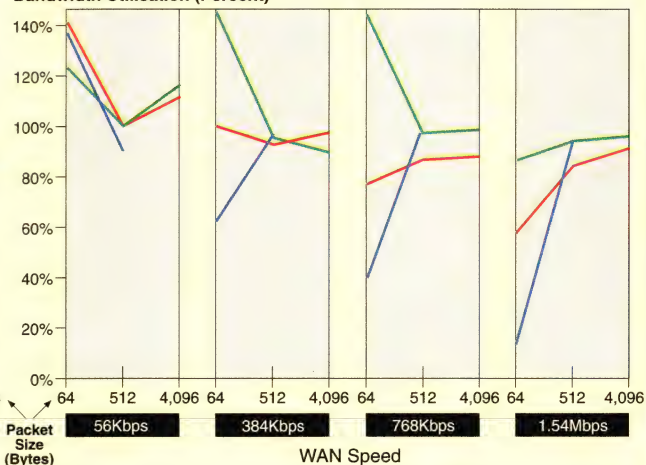


Figure 5: IPX Over Token Ring

Bandwidth Utilisation (Percent)

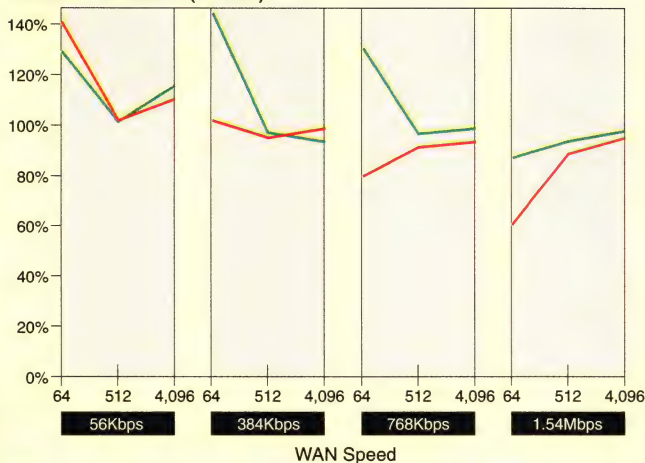
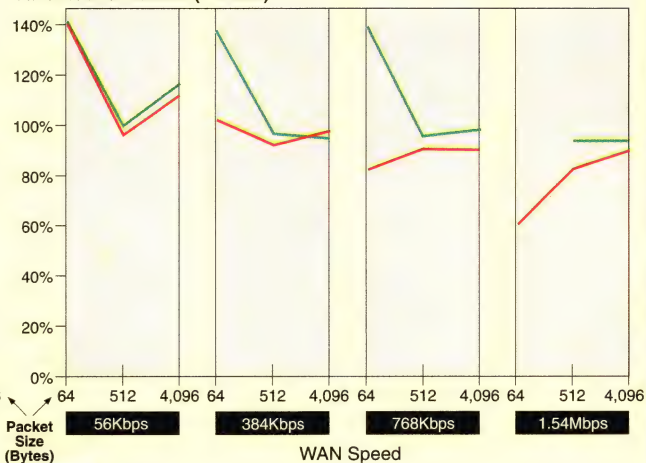


Figure 6: IP and IPX Over Token Ring²

Bandwidth Utilisation (Percent)



■ IBM Routexpander
 ■ Newport Mega
 ■ Newport MPR
 ■ Novell MPR

1. IBM Routexpander could not pass 4,096-byte packets without segmentations.
2. Newport LAN2LAN/Mega could not be tested at 1.54Mbps for 64-byte packets.

PC-Based Routers in Perspective

VENDOR	PRODUCT	VERSION TESTED	INTENDED PLATFORM	DATA COMPRESSION	LAN PROTOCOLS	WAN PROTOCOLS	BRIDGING METHODS
IBM 13 24 26	Routexpander/2	1.0 (Routexpander) 1.2.1 (TCP/IP for OS/2)	Server	No	IP	PPP, frame relay, HDLC	Source route (Token Ring)
Newport Systems Solutions LAN Systems (02) 901 3655	LAN2LAN/Mega	3.02	Server	Yes	IP, IPX, AppleTalk	PPP, X.25, HDLC	None
	LAN2LAN/MPR	3.0	Standalone PC	Yes	IP, IPX	PPP, X.25, HDLC	Transparent (Ethernet)
Novell (02) 413 3077	Multiprotocol Router Plus (MPR Plus)	2.1	Server or standalone PC	No	IP, IPX, AppleTalk, OSI	PPP, X.25, IPXWAN	Source route (Token Ring)
HDLC = High-level Data Link Control IPX = Internet Packet Exchange PPP = Point-to-Point Protocol							

In addition to PPP, Novell also offers its own take on router-to-router communications. In view of the ever-expanding variety of WAN services — including X.25, frame relay, and ISDN — Novell developed an extension to its IPX protocol called IPXWAN, which works independently of the underlying wide area network. Novell has formed alliances with most major router vendors, all of whom plan to add IPXWAN to their high-end backbone routers.

The lack of data compression is a serious shortcoming in a PC-based router likely to be used with expensive WAN links. Newport alone of the vendors tested offers built-in data compression, significantly boosting its effective throughput across the wide area. At the time of testing, though, Newport's compression module only worked at 128Kbps or less (it has since announced compression at E1 speeds (2.048Mbps).

But even without compression, effective throughput exceeded 100% of WAN speed in nearly one-third of our 204 tests (thanks to header stripping and other techniques).

Simplicity is one of the biggest arguments used by vendors of PC-based routers, who tout the familiar look and feel of PC software as a major benefit. Indeed, interfaces for the Newport and Novell products resemble those for Novell's NetWare, and IBM's Routexpander/2 can be configured through the same OS/2 setup routines used for the vendor's LAN Server network operating system.

But the simplicity theme is starting to sound a bit (shall we say) oversimplified. PC-based routers are easy to set up and manage, but so are low-end proprietary routers such as the Wellfleet Feeder Node and the OG-RAN from RAD Network Devices. Configuring either type of product involves little more than powering up and specifying IP addresses or IPX network numbers (or both). And other vendors of proprietary boxes have introduced products intended specifically for novice users and small sites, including Cisco Systems, Proton and 3Com.

SNMP is a given with both PC-based and proprietary routers. PC-based products may have a slight edge because of PPP; such support enables their SNMP agents to report to management stations over more kinds of links.

Defining and measuring router performance continues to be a fiercely debated subject among network managers. In fact, asking any three net managers to define router performance is likely to produce (at least) three different responses.

In testing routers, we try to equalise the offered load (the amount of traffic we send into the test bed) and the delivered load (the amount that reaches the destination LAN). That point of equilibrium (the steady state) is a good indicator that the router is performing optimally, without dropping any packets. In our view, steady-state testing is the most valid method of gauging performance, but it doesn't account for the bursts and overloads that will be encountered in the real world. When a server is handling requests from multiple users over a WAN link, for example, it doesn't check to see whether the responses to the requests can fit into a router's buffers; it simply fulfills the requests. As a result, the router may be offered a load far larger than the WAN link can handle. At an absolute minimum, the router should handle the burst without crashing; in a best-case scenario, the router should have enough processing power and enough buffer memory to keep performance from flagging.

Of the routers we examined, only Newport's two entries were able to handle an offered load of up to 10Mbps without crashing. Still, IBM's and Novell's routers were capable of fielding loads to 7.5Mbps — higher than the normal data rate on most Ethernets and good enough to be viewed as impressive.

Test Results

To get a good sense of how PC-based routers stand up under a wide range of conditions, we tested them at a range of WAN speeds (from 56Kbps up to US T1 speeds

(1.536Mbps)) using a variety of packets and protocols (see Test Methodology).

Wherever possible, we evaluated each product as follows: with IP over Ethernet; IPX over Ethernet; IP and IPX over Ethernet; IP over Token Ring; IPX over Token Ring; and IP and IPX over Token Ring. We offered a 50-50 mix of IP and IPX to the routers that support both protocols; IBM's Routexpander/2 handles IP only.

Our test traffic consisted of small, medium, and large packets (64, 512, and 1,518 bytes for Ethernet; 64, 512 and 4,096 bytes for Token Ring). Traffic was transmitted at WAN speeds of 56, 384 and 768Kbps and 1.536Mbps. A total of 204 tests were run to determine how effectively PC-based routers utilise available WAN bandwidth.

All in all, we found PC-based routers to be adequate, and at times excellent, performers. WAN bandwidth utilisation often exceeded 100%, particularly when sending 64 byte IP packets over Ethernet (see Figure 1). A notable exception was IBM's Routexpander, which utilised far less WAN bandwidth when working with 64 byte packets than with larger packets at all WAN speeds above 56Kbps. Even with IBM's poor showing in small packets, however, average bandwidth utilisation of all types of IP traffic over Ethernet was 96%.

The figures are even more impressive for IPX traffic over Ethernet (see Figure 2). The average bandwidth utilisation rose to 100%, and none of the three routers tested in this area (the Newport and Novell products) slowed up significantly at any one packet size or WAN link speed.

Mixed-protocol streams of IP and IPX traffic had little, if any, effect on performance (see Figure 3). Average bandwidth utilisation for all products was 98%, which is only 2% less than the average for IPX-only traffic and actually 2% higher than the IP-only average. This finding brought an interesting anomaly to our attention: in a few cases, the Newport and Novell routers handled multiprotocol streams slightly faster than single-protocol streams. Engineers

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at both companies were unable to explain this phenomenon.

Average utilisation levels rose even higher on Token Ring LANs. When we sent IP traffic over Token Ring, for example, utilisation rose above 140% in some cases (see Figure 4). Average utilisation for IP over Token Ring was only 87%, nevertheless, this figure reflects the inability of IBM's Routexpander to handle 4,096 byte packets without segmentation. Without IBM's 4,096 byte figures, average utilisation rises to 97% — a 1% improvement over the Ethernet results.

IPX over Token Ring tended to out-perform IP, much the same as with Ethernet (see Figure 5). Average utilisation was 102% of the WAN speed. Traffic tended to fill less of the WAN pipe at higher link speeds — a characteristic that was true of all the tests to some extent but most pronounced in this case.

The most impressive average utilisation of all was combined IP and IPX traffic over Token Ring, which rose to 103% — a 5% boost over the Ethernet level (see Figure 6). The two products tested in this category — Newport's LAN2LAN/Mega and Novell's MPR Plus — both utilised more than 100% of WAN bandwidth in all cases at 56Kbps speeds.

IBM

IBM's Routexpander/2 has three good things going for it. First, it's the least expensive product we tested. Second, it supports source route bridging, a must for customers with lots of unroutable SNA traffic. Third, it turned in respectable performance in some T1 tests. But there's still plenty of room for improvement. The Routexpander underperformed its competitors in most tests; it only routes one protocol, IP; and it was unable to pass 4,096 packets without segmenting them.

The Routexpander/2 is an OS/2 application that can run in a standalone configuration or on a server running OS/2 and IBM's LAN Server. In either configuration, two software packages are required for routing: IBM's TCP/IP for OS/2 and Network Transport Services/2 (NTS/2), a set of OS/2 communications protocol stacks. The Routexpander, the IP stack, and NTS/2 each have their own setup routines; while none of the routines were inordinately complex, it's cumbersome to have to run all three.

On the hardware side, the Routexpander/2 uses the IBM Wide Area Connector (WAC) card, available, in both ISA (Industry Standard Architecture) and Micro Channel (MCA) versions, each with a variety of WAN interfaces.

IBM supplied the Routexpander/2 with Etherstreamer LAN adaptor cards, the Ethernet cousins of Big Blue's LANstreamer Token Ring adaptor cards, which are among the fastest we've ever tested. But IBM chose to supply its 16/4 Token Ring cards rather

than LANstreamers for the Token Ring tests. Thus, it's not surprising the Routexpander/2 lagged further behind in the Token Ring tests than in the Ethernet ones.

We ran into a more serious problem on the Token Ring side: segmentation of 4,096 byte segments. Because segmented traffic requires reassembly or retransmission, we cannot accept this as a valid test result. We also concluded that the Routexpander/2 is unable to handle 4,096 byte packets, at least in its current version.

We verified our findings with IBM, which conceded that segmentation took place with packets that exceed 2,048 bytes. We traced the problem to the 8,192 byte buffer used for receiving and transmitting. In theory, an 8,192 byte buffer should be able to accommodate two 4,096 byte packets — one packet being received from the attached PC and one packet being transmitted over the wide area. In practice, however, the buffer also handles control blocks and other overhead traffic, so it cannot hold 4,096 byte packets without segmentation.

Newport Systems

Founded in 1988, Newport was one of the earliest entrants into the PC-based router market. Its router software was OEM'd by Novell before the latter developed its own products, and Novell continues to OEM Newport's WAN adaptor card. Newport's routing experience was evident in our performance tests, where it consistently led the field.

Newport makes two routers, both of which are NetWare Loadable Modules (NLMs). The LAN2LAN/Mega is intended for a Novell NetWare file server, although it also can be used in a dedicated box. The LAN2LAN/MPR is meant for a standalone PC; it also is available in versions that work with other LAN operating systems such as Vines from Banyan Systems, Windows NT from Microsoft, and Lantastic from Artisoft. The LAN2LAN/MPR works only with Ethernet. Notably, the LAN2LAN/Mega routes IP, IPX, and AppleTalk traffic; the LAN2LAN/MPR is limited to IP and IPX.

Both products are bundled with Newport's Wide Area Network Interface Co-processor (WNIC) card, which is available in ISA, EISA (Extended ISA), and Micro Channel versions, each with a variety of WAN interfaces. As noted, WNIC features an optional module for data compression. Other modules allow up to 12 WAN interfaces to be attached to a single card (or a maximum of six interfaces when data compression is used). Novell has a slight advantage on WAN connectivity: its software makes it possible to put up to 16 WAN interfaces on a router.

The LAN2LAN/Mega posted the highest speeds of any router in this test. It utilised over 100% of WAN bandwidth when

handling streams of IP-only and IPX-only traffic, both over Ethernet and Token Ring.

Newport's routers stood out for their ability to handle bursts of traffic. As an adjunct to our Ethernet performance tests, we offered full 10Mbps loads, to both routers while they were working at each of the four WAN speeds we tested at. Neither router crashed, despite being flooded with full-throttle traffic for five minutes or longer — a good indication that the Newport gear is capable of connecting heavily used LANs.

Novell

As the leading vendor of LAN operating system software, Novell has something going for it that no other vendor can claim: the comfort factor. The installation and management screens for its Multiprotocol Router Plus (MPR Plus) use the same menu-driven format as those for NetWare. And MPR Plus offers the tightest links to other NetWare services, such as NetWare for SAA, the Novell Network Registry, and local and remote monitoring utilities.

MPR Plus also supports the greatest number and variety of connectivity choices. It routes more protocols than any other PC-based router we checked: IPX, IP, AppleTalk, and OSI. It supports source route bridging of Token Ring traffic, which, when used with IPX routing, makes it a very good choice for sites that mix SNA and NetWare. On the WAN side, it supports up to 16 wide area interfaces — again, the highest number in this test.

MPR Plus and its LAN-only counterpart, MPR, also include NetWare Hub Services, a series of NLMs that manage network port traffic. By using the hub NLMs, network managers can integrate both router and hub functions into a single PC.

Despite all these advantages, however, Novell's MPR was not the strongest performer. Its throughput figures, while always respectable, were usually below those of both Newport routers, especially when handling small packets. Curiously, one of Novell's weakest performances was in its bread-and-butter market: routing of IPX traffic over Ethernet.

Still, while Newport beat out Novell, performance differences were dramatic in only a few cases, such as when handling a mix of IP and IPX traffic over Ethernet at T1 speeds. In most cases, however, Novell's performance showed remarkably little variation across all packet sizes and WAN links. Net managers could do far worse than Novell's single-vendor approach to LAN-WAN connectivity.

Kevin Tolly is Director of the Data Comm Test Lab and President of Interlab. He is based in Sea Girt, New Jersey. David Newman is Testing Editor for Data Communications magazine, based in Boston.

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PABX Networking

Why is Spectrum Access Constrained?

The launch of a suite of intelligent network (IN) products under the name CustomNet in 1990 represented a highly significant directional change for Telecom Australia. Not only did these services use the computing capabilities of the digital exchanges, they also largely used different main exchange platforms. Furthermore, while CustomNet-13 and Horizon were developed by Telecom, CustomNet Spectrum was largely purchased from NorTel (Northern Telecom), the supplier of the DMS-100 exchanges from which it is provided.

Nevertheless, as attractive to customers as these services are, they were introduced at a time when most large organisations had built large private PABX-based networks. CustomNet-13 and Horizon were easily grafted onto such PABX networks, as indeed they complement PABXs, especially unnetworked PABXs. But CustomNet Spectrum itself, on the other hand, is not a complementary technology to a PABX, it is a total alternative.

Initially, Spectrum has been offered only on NorTel DMS-100 exchanges and because the Telecom network only has a small number of these, its geographic availability has been limited. However, Telecom does plan to extend the service to Ericsson AXE and Alcatel System 12 exchanges, largely overcoming this limitation.

Yet, the concurrent use of both Spectrum and a PABX network within an organisation are not mutually exclusive. While some organisations have implemented Spectrum-only networks, others, including Australia Post, the AMP Society, some Commonwealth Government departments and at least one bank, have implemented Spectrum at some sites and retained PABXs at others. For these customers, there is an obvious need to integrate the Spectrum site, or sites, with the PABX network and this is a need that Telecom Australia still has a long way to go to fulfill.

When Spectrum was first introduced, no means of interfacing a Spectrum service to a PABX was offered by Telecom, despite both E1 (2.048 Mbps) and analogue tie-line interfaces being available on the DMS exchange. Instead, customers are offered a compulsory bundling of PSTN, ISDN and/or Horizon as a part of Spectrum. Thus, Austel could conceivably rule that this was in violation of

Section 181 of the *Telecommunications Act*. Furthermore, or alternatively, the barrier to the use of competitor services this non-offering imposed on Spectrum customers could conceivably be found to be in violation of Section 37 of this Act.

However, Deirdre O'Donnell, Austel's Manager of Industry Practice and Licences, stated that a number of tests would all have to be met before either such assessment could be made. The non-offering of a full PABX-to-Spectrum interface "would need to be more fully developed to assess whether section 181 (or 37) applies."

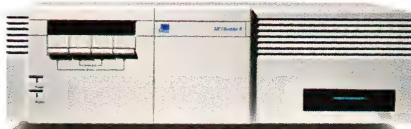
A Limited Solution

Nevertheless, earlier this year, Telecom introduced a limited form of such an interface called Constrained Access. While Constrained Access provides some connectivity between a Spectrum service and a PABX, the need for an E1 interface from Spectrum service to that customer's PABX remains.

Constrained Access is an unpublished (it's not included in the Basic Carriage Service tariff) Spectrum-to-PABX interface using ISDN switched connections from an AXE exchange to the PABX. A dialling plan for the Spectrum site is configured into the main exchange to translate and route calls to the PABX via the ISDN route.

We came. We s

Of course, we're not normally ones to boast, but in this case, it's too hard to resist. Recently, *Communications Week* tested several internetworking devices in multi-protocol environments. 3Com's NETBuilder II® earned a perfect score in every single test



scenario. The first perfect overall score recorded. Anything they could dish out, this router could take.

Surprised? We weren't. After all, NETBuilder II was designed to be the most powerful, flexible router made.

So powerful, its advanced RISC processor and high-speed bus make it one of the industry's top performers. At a price that's almost a third less than our biggest competitor.

And so flexible, it can support Novell's IPX, AppleTalk,

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First Perfect Over

Cisco device takes a licking, but 3Com bridge-router keeps on ticking

By EDWIN E. MIER
AND CHRIS GIULIANO

When bridge-routers from Cisco Systems Inc. and 3Com Corp. were evaluated for this installment of *Communications Week's* mixed-LAN test program, it was 3Com's NetBuilder II that carried home the awards.

In fact, the NetBuilder II is the only bridge-router among the six tested to date in our series to command a perfect score for all test scenarios.

The NetBuilder II successfully handled the worst traffic scenarios we could throw at it, without skipping a bit.

That performance, coupled with a price tag that is considerably lower than many oth-

er market leaders', made 3Com's bridge-router an excellent choice for users intending token-ring and Ethernet LANs.

In performance, Cisco's bridge-router clearly lagged behind the 3Com device. MGS—a product that, older than the vendor's 407000 series bridge-route still marketed by Cisco—tested both at a user site and in our labs, despite the vendor's decision not to participate in the test program.

The Cisco bridge-router is most adept at processing net and Novell Inc. Inter-Packet Exchange traffic. It handles the maximum DECnet traffic load in 60 of the test scenarios.

Testing



3Com Is Latest

COMMUNICATIONS WEEK

By tariffing Constrained Access according to semi-permanent connection (SPC) rates, users are not slugged with individual call charges, yet are able to connect to PABXs that use software that may support only switched ISDN.

Nevertheless, Constrained Access has its limits. First of all, as the dialling plan is within a database in the DMS exchange and congestion is most likely to occur on the ISDN link from the AXE exchange to the PABX, alternate routing is not available for calls that are blocked due to congestion on or failure of this ISDN link. Furthermore, when such congestion does occur, the Spectrum extension caller receives an engaged tone, not a congestion tone.

The second limitation is that Constrained Access is a unidirectional interface—it only carries calls from the PABX to the Spectrum site (although bi-directional Constrained Access has been implemented for the AMP Society). Customers are encouraged to use CustomNet Horizon for calls from the PABX to the Spectrum site or sites. But not only are calls using Horizon tariffed on a per call basis, this configuration makes a PABX-based centralised attendant facility for both the PABX and Spectrum sites unviable.

Thirdly, calling line identification (CLI) is not passed on the Constrained Access

Table 1: Interfacing PABX With Centrex				
SUPPLIER	PABX	SWITCHED ISDN SOFTWARE	DIGIT INSERTION/ DELETION PRIOR TO LCR	INTERFACE TO CENTREX IN OTHER COUNTRIES
Alcatel	4300	AU6	No	No
Fujitsu	9600L	Release 4	Yes	No
GPT	ISDX	3.5	Yes	No
NEC	2400 IMS	5000	Yes	N/S
	2400 SDS	2460		
NorTel	Meridian SL-1	Phase 6	Yes	Yes, T1 (1.54Mbps) using channel associated signalling

LCR = Least Cost Routing N/S = Information Not Supplied

link, although this may change according to Telecom's Manager of CustomNet Spectrum, Phil O'Sullivan: "CLI can today not be provided selectively by customer (it's from all or from none) from the DMS exchange. This discrimination will be able to be provided and with it, the CLI, subject to privacy issues, by about mid-1994." Thus implemented, however, CLI will still not be able to be provided for the PABX-to-Spectrum calls that must use Horizon.

The fourth issue is the number of digits that are able to be forwarded on a Con-

strained Access link. Least cost routing to interconnect numbers is available, according to Phil O'Sullivan as "the 11-digit length limitation does not include the header and is available to the customer." However, the AMP Society has been told that they cannot forward extension numbers that are on interstate PABXs, although networked, on this link and another customer has not been able to forward more than five digits.

Finally, whatever form of centrex-to-PABX connectivity the user community eventually gets out of the carriers, there is

aw. We routed.

Score Earned

3COM'S PERFORMANCE IN A MIXED-LAN ENVIRONMENT

ic streams from an Ethernet and a token-ring LAN were sent to a 3Com NetBuilder II ge-router simultaneously. To reflect real-world conditions, packet sizes and the number of ies on both LANs were varied. The traffic load was increased in 10 percent increments, up (the maximum that can be exchanged between the LANs in each scenario. The figures in the ds represent (as percentages of the maximum possible) the levels at which the device (processed bidirectional traffic before it began to drop packets. Results are given for each uted protocol tested and for transparent bridging.

	No. of nodes	Packet size in bytes				
		Ethernet to token-ring				
AppleTalk	Ethernet/token-ring	64	128	512	128	64
	100/1	100%	100%	100%	100%	100%
	50/50	100%	100%	100%	100%	100%
	1/100	100%	100%	100%	100%	100%
	100/100	100%	100%	100%	100%	100%
DECnet	Token-ring to Ethernet					
		512	512	128	128	64
	Ethernet to token-ring	64	512	1,500	128	64
	100/1	100%	100%	100%	100%	100%
	50/50	100%	100%	100%	100%	100%
IP	1/100	100%	100%	100%	100%	100%
	100/100	100%	100%	100%	100%	100%
	Token-ring to Ethernet					
		1,500	512	64	128	64
	Ethernet to token-ring	64	512	1,500	128	64

IBM NetBIOS/NetBEUI, Banyan VINES, DECnet, XNS, OSI, and TCP/IP protocols. Not to mention any LAN or WAN media, including FDDI and other high-speed media that come along.

NETBuilder's modular design means interface, media, topology, and technology changes can be made in no time. Plus, hot-swappable modules make network problems easy to repair, with absolutely no interruption in service. In fact, meantime board replacement is less than five minutes. Want to know more about NETBuilder II? Give us a call at (02) 959-3020, ext. 20.

We'll send you a copy of our perfect test results, and show you the most powerful way to conquer your internetworking needs.



Networks That Go the Distance®

Table 2: Extension Facility Code Flexibility

SUPPLIER	PABX	DEFAULT CODE SET	CODES IN USER GUIDES	CAN CODES BE CHANGED?	RESTRICTIONS ON CODE SELECTION	TWO CODES FOR SAME FACILITY	ONE CODE FOR BOTH PREFIX CODE AND SUFFIX CODE	'9' FOR CONSOLE AND 9XXX EXTENSION NUMBERS
Telecom	Spectrum	Yes	Yes	Yes (DMS only)	No double * or double #	Yes	No	No
Alcatel	4300	Yes	Yes, but space for user choice	Yes	Max length of 4 chars	Yes	Yes	Yes
Fujitsu	9600L	Yes	No	Yes	Max length of 6 chars	Yes	Yes	No
GPT	ISDX	Yes	Yes	Yes	Max length of 4 chars	Yes	Yes	No
NEC	2400 IMS	No	No	Yes	Max length of 5 chars	Yes	Yes	Only with hotel/motel software
	2400 SDS	Yes						
NorTel	Meridian SL-1	Yes	Yes	Yes	Max length of 7 chars	Yes	No	Yes

more to the integration of a PABX network with a centrex service than physical connectivity, just as there is more to interfacing two dissimilar PABXs than the much vaunted issue of feature transparency.

The most obvious difference lies with the system integral handsets (SIHs). Every PABX model can interface only to its own proprietary SIH, despite the frequent claim of some sort of adherence to the ISDN basic rate 2B+D standard. The DMS exchange, too, supports its own SIHs, both ISDN and proprietary, which are different from any used by any of the PABXs.

The second issue is that of extension facility codes. What is needed is a set that's common, even if not identical, across two or more switching platforms, be they a PABX and centrex or just different PABXs.

Although these are limitations, extension facility codes can be changed for DMS-based Spectrum. However, although similar flexibility is available from at least the AXE according to Ericsson, Telecom says that such extension facility code flexibility will not be offered for Spectrum from the AXE or System 12 exchange platforms. While all of the PABXs listed in Table 2 allow some

flexibility with the selection of such codes, at least one PABX, the supplier of which declined to respond to this survey, does not permit any of its facility codes to be changed, even though its codes are difficult to commit to memory.

Some other suppliers, while permitting codes to be changed, print user documentation with their default set, inhibiting such a change. An engineer at one of these suppliers admitted that their default set was cumbersome, with new facilities assigned to the next unused codes. But as there are bound to be individuals within an organisation opposed to changing an initially implemented code set, a user-friendly set is best devised prior to the system's installation.

Finally, there is the issue of feature transparency. Extension feature transparency requires an inter-PABX signalling protocol, and an inter-PABX signalling protocol requires a leased interface such as an E1 circuit. The DPNSS protocol is supported on the 2.048Mbps (E1) PABX-to-protocol exchange interface offered by Mercury in the UK for its centrex customers. Both Mercury and Telecom Australia use NorTel DMS exchanges for centrex.

But Phil O'Sullivan said that DPNSS is not offered by Telecom because "it is not supported by the current DMS software in Australia." He went on to say that "it is being investigated and when it is offered (by the DMS exchange), any customer offering will require a position to have been agreed to by Telecom, Optus, Austel and the customers."

As only the GPT ISDX and Ericsson MD110 PABXs currently support DPNSS, channel associated signalling (CAS) which is described in such standards as R2, R2D and Telecom's T6 would have to be used for a connection between Spectrum and any other PABX model.

So finally, what can a customer needing to interface a Spectrum site to a PABX expect? In the short term, they can take comfort that Telecom is working on providing a moves and changes facility and a source of call detail records for customers' TIMSs. In the long term the situation remains unclear, but perhaps if ATUG and its members lobbied hard enough a full-blown 2.048Mbps Spectrum-to-PABX interface could be offered sooner, rather than later.

Stephen Coates

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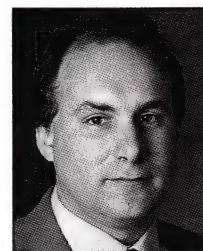
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Graeme Le Roux

The Boundary of Credibility

Since 3Com's release of its Boundary Routing System Architecture (aka Boundary Routing) I have spent a good deal of time explaining what the concept is and how it works. Quite a bit of confusion has arisen over the subject, partly due to 3Com's choice of terminology and the usual claims and counter-claims of the industry's marketing machines, but mostly because there are still a large number of network administration and support personnel who do not understand the mechanics of bridging and routing. In the interest of shedding some light on the subject, I'll devote this column to 3Com's version of Boundary Routing in particular (there are others, such as RND's Central Access Routing).

First some terminology; 3Com has developed a method of simplifying the topography of an internetwork (i.e. a number of discrete networks linked via routers) which it has patented as the Boundary Routing System Architecture (BRSA). For simplicity 3Com has adopted (and as a marketing tactic, patented) the term *Boundary Routing* as an abbreviation for BRSA. A Boundary Router is a combination of physical devices which perform the functions of a router within the BRSA. Specifically a Boundary Router is a NetBuilder I or II at a central site, a WAN link and a NetBuilder Remote Access/Control (NRAC) unit at a remote site. The fact that a Boundary Router comprises two discrete 3Com products is the source of much of the confusion on this subject.

The key architectural point which makes 3Com's BRSA possible is that a router is a two-stage device; it makes two separate decisions about any packet it encounters. The first is whether or not to do anything at all about the packet. For example, an IP router instantly drops a broadcast packet when it appears on any port, while a normal packet is forwarded to a second stage in the router's software where a routing decision based on destination network address is made. 3Com's boundary routers physically separate these decision sets. The simpler forward or drop decision is made at a remote site by a NRAC, while the more complex routing decisions are made at central sites by either a NetBuilder I or II.

The main advantage of this approach is that the number of physical devices making routing decisions in an internetwork is reduced drastically. Consider an internetwork of ten sites. Under normal circumstances this means you have up to ten routers, each of which performs route computations and holds routing tables. If one link goes down, whichever routing algorithm is in use has to converge over ten routers. Using Boundary Routing you would have two NetBuilder I or IIs and eight (or nine) NetBuilder Remote Access/Control units. If a link goes down only the two NetBuilder I or IIs re-compute their routing tables. You also have only two devices to administer because the remote units — being basically forwarding engines — have essentially static configurations. The corollary — and limitation — here is that NRAC units cannot handle redundant paths, since they can't make routing decisions on their own. If you want to manage redundant paths to remote sites you have to use a normal router. From a practical standpoint this limitation is not much of a problem. The cost of a router is, in general, dwarfed by the cost of telecommunications links, and, as a result, most organisations can only justify redundant links between a small pro-

portion of their sites. Most of the wide area links in the corporate world are single point-to-point links with no redundant path. Such links are perfect for the implementation of Boundary Routing.

Practicality also dictates that a NRAC unit has to be a little more than a simple forwarding engine. If it weren't then it would simply drop broadcast packets and forward everything else, which would risk swamping its WAN link and would involve the central NetBuilder in a large amount of extra processing.

There are two ways of avoiding this problem; you can filter on network address or forward on the basis of address — that is, bridge. The problem with the former approach is that you have to set up a filter for all protocols (the NetBuilder is a multiprotocol router). It is much easier, faster and cheaper to do some basic bridging on the basis of the MAC layer address — i.e. take the latter approach, which is what 3Com has done. Quite incidentally this cuts the processing load on the central NetBuilder and thus increases the throughput of the Boundary Router as a whole. The solution is not perfect — you must still send both ARP requests as well as the first packet from any station not in the NRAC unit's address table across the WAN link to be handled at the NetBuilder, but this is a relatively trivial amount of traffic unless the remote site is very large.

This brings up the second major area of confusion regarding Boundary Routing; the NRAC units are basic ISO/OSI bridges, but they are not 3Com Boundary Routers, nor can they be used on their own to provide a simple point-to-point WAN link as two standard bridges can. 3Com is trying to make the components of their Boundary Routers as simple, and therefore cheap, as possible.

Of course you don't have to buy 3Com products to simplify an internet — you can use a combination of ordinary routers and bridges to do similar things. Just buy a router and a basic bridge which can communicate over a WAN link via PPP. Set the bridge to filter on the local network address and/or broadcasts — contrary to the word of many vendors, you don't need a router at both ends of a WAN link, nor must you have a bridge front-ending a router

at a central site if bridges are deployed at remote sites!

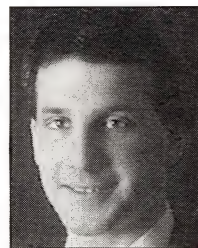
This approach is expensive, because the bridges which you buy have to be designed to function as full-blown ISO/OSI bridges with all the bells and whistles, rather than the front end of a Boundary Router. This means a powerful CPU(s), complex software, and the hardware to handle multiple interfaces. 3Com's remote units are designed only to function as the front end of a Boundary Router, and are therefore very cost effective. The overhead of added software on the NetBuilder I and II is more than compensated for in the reduction in packet processing achieved.

In summary, 3Com's BRSA addresses the issues of path complexity in large internet topographies, conserves not only internet address space (since WAN links need not be sub-nets) but, most importantly, the costs of equipment acquisition, deployment, maintenance and administration. It is not an appropriate solution in all cases — but no other vendor has a 100% applicable solution either.

"The key architectural point which makes 3Com's Boundary Routing Systems Architecture possible is that a router is a two-stage device."

Graeme Le Roux is a Director of Moresdawn Pty Ltd (Bundanoon, NSW) and specialises in local area network consulting services.

Can DEC Dig Out?



Eric Hindin

When a company is better known for layoffs and quarterly losses than for being the first major system vendor to support LANs, host clustering, and middleware — and still the only one with distributed directory services — it's got more than its share of troubles.

Digital Equipment Corporation's problems are a result of a multitude of sins. The shortlist looks like this: VAXes fell behind RISC workstations and PCs on the price/performance curve. DEC salespeople continued to hawk VMS and proprietary solutions even when customers asked for Unix (over and over). The company bet on OSI and Microsoft's LAN Manager (remarketed as Pathworks), while the rest of the world went with multiprotocol networks and routers and Novell's NetWare. DEC didn't just fall into a hole; it took several years to dig a pit for itself. For the past few years, though, it's been working hard to climb back out, and its efforts culminated in the announcement late last year of more than 135 products — from new Alpha processors to net management utilities.

DEC is on the right track. It's identified a large new market in what's being called network infrastructure equipment and services — chiefly, client-server application development and management tools. And it says products are on the way. Neither is a guarantee of success. DEC's competitors — and there are plenty of them at this point — are wise to the same market opportunities. And when the feeding frenzy starts, there won't be enough to go around.

In a way, DEC is hoping to repeat its earlier successes. Remember, it was one of the first vendors to introduce a peer-to-peer network architecture for LANs. In doing so, it got a big jump on rival IBM when it came to deploying mission-critical applications that were easier to manage, more flexible, and less expensive.

DEC obviously thinks the time is right to do the same thing again. Today's internetworks are sagging under the weight of unwieldy client-server applications. Worse, the much-needed directories, backup systems, and management tools are either unavailable or proprietary. Translation: DEC once again has a chance to implement mission-critical applications on relatively cheap hardware.

And today, just as in the past, the network is the key. True, DEC is only going to stop hemorrhaging red ink if it can sell plenty of PCs and workstations built with its Alpha RISC processors. But there's only one thing that's going to get corporate IS managers and net managers to line up, and that's if a supplier's networking software gives them what they can't get from anyone else.

The basic building block of DEC's networking strategy is Pathworks. This isn't the product of old, which only supported LAN Manager. These days, the package accommodates LAN Manager and NetWare for PCs running ODS or Windows; Macintosh computers; and Alpha machines loaded with Windows NT, OpenVMS, and OSF/1 — and that's just on the client side. Pathworks servers can run LAN Manager (on PCs under Windows NT or Alphas configured with NT, OpenVMS, or OSF/1) or NetWare (on PCs running native NetWare or Alpha stations under OpenVMS), and a version of NetWare that runs on top of OSF/1 is in the works.

DEC says it will produce management software and distributed applications for all its clients and servers. Advantages in terms of

processing power are notoriously short-lived, and any edge that Alpha has over IBM's PowerPC or Intel's Pentium is almost certain to be reversed in short order. Unfortunately, DEC's strategy doesn't sound much different from what you would expect to hear from IBM, Data General, Hewlett-Packard or (in Europe) from Siemens-Nixdorf, ICL or Bull. All these companies are looking to make popular network software like LAN Manager and NetWare available across a wide range of platforms and deliver the requisite network infrastructure software. True, IBM is pushing PowerPC rather than Alpha and runs LAN Server on top of OS/2 instead of Windows NT, but these are differences of degree rather than of kind.

At present though, DEC has done something that few of its competitors can claim — announced products. It's possible to get a sense of what DEC is up to by comparing one of its network management products with whatever is available from arch-rival IBM.

What the market needs is a product that can simultaneously manage different types of servers. This would give administrators a single window into the enterprise through which they could keep an eye on NetWare and LAN Manager servers and all authorized users. They could create user accounts, assign access rights, monitor storage space, and — in the best of all worlds — also manage their host-based systems from the same console.

Up until the DEC announcements, neither it nor IBM could offer anything close to what was needed. Pathworks servers and NetWare servers had to be managed separately. And even though the same hardware could act as a Pathworks server and a host, no common management was possible. It's pretty much the same story for IBM: mainframes are managed by NetView and SystemView; LAN Server looks after its own, as does NetWare.

But the DEC announcement of a product called Manageworks looks to put it far out in front of Big Blue. No, Manageworks can't deliver integrated management for all servers and hosts, but it does put Pathworks servers, NetWare servers, and Microsoft

LAN Manager servers on the same console.

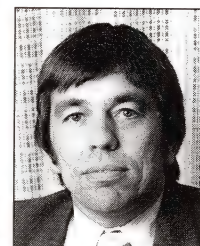
The Manageworks Windows interface lists all servers on the same screen. Click on any server, and the program will query it and display specific attributes. All the information is presented in a fairly consistent format. If Manageworks delivers everything that's promised, it will allow some of the management programs specific to servers to be replaced. The best solution would be to allow administrators to use exactly the same commands to manage all the servers. This is very tough to do, since the functions of one piece of equipment may not map to another. With NetWare, files in subdirectories automatically inherit the access rights of the parent directory; with LAN Manager, they receive default access rights unless otherwise specified.

I'm not suggesting Manageworks is perfect, but it's a step in the right direction (but how big a step remains to be seen.) So far, IBM hasn't announced anything comparable; the closest it's come is with its just-announced LAN NetView software for OS/2, which lets different types of servers and clients be monitored.

Eric Hindin is Senior Technology Writer for Data Communications magazine, based in Boston.

"DEC didn't just fall into a hole; it took several years to dig a pit for itself."

Naming and Addressing — TCP/IP's Achilles Heel



Alan Lloyd

OSI standards are very often criticised for being too slow, with some saying that, as a consequence, they will be displaced by the TCP/IP protocol suite for 'global' networking. Is this criticism of OSI valid? Is a truly global TCP/IP network practicable? In both cases the answer is no.

OSI is the seven-layer framework on which standards can be developed for distributed systems. A framework, as the model or the standards that apply to OSI, cannot be slow (though the standards themselves may sometimes seem slow to appear!). Abstract frameworks, piles of paper, the standards that specify technology, are not slow. So it is the implementation of OSI standards that is being criticised, not the standards themselves.

Many 'OSI' standards have already been successfully implemented, including V.24, V.35, G.703/4, Ethernet, Token Ring, HDLC and X.25. These are not slow and they are all used with higher layer OSI, de facto and proprietary protocols.

At the network level, compare the IP and CLNP standards. They are basically the same except that the OSI CLNP has ISO-defined addressing schemes with 20-byte fields instead of IP's four bytes. It takes almost no time to process these extra bytes of the protocol, and the longer address has significant benefits.

At the transport level, ISO Transport and TCP are not too dissimilar, except that the higher, more complex classes of the ISO Transport service (class 3 and 4) have optional features such as check summing and timers. These options increase the quality of service to the transport user by increasing transfer robustness. If you do not choose these options, the 'speed' of ISO Transport and TCP protocols should be much the same.

At the higher layers, although FTAM is more complex than FTP and TFTP, it does provide optional functionality such as file/record level access. In the mail/messaging area, X.400 messaging is more complex than SMTP because it defines a robust messaging system that is required by carrier type services. For example, X.400 provides message transfer integrity, message delivery reports and receipt notifications and tracing. There is the functionality needed

to build a commercially acceptable, business oriented, global messaging/EDI system. SMTP is really provided for casual e-mail because it is simple (the S in SMTP stands for simple) and does not provide message delivery or non-delivery mechanisms.

In saying that OSI is slow, critics need to explain why it is slow, what standard is used, what platform it is on and under what conditions it is running and, most importantly, whose implementation it is. What seems to be happening is that the LAN/PC end of the technology spectrum is being compared to the carrier and large scale networking technologies. It is like comparing a skateboard with a four wheel drive vehicle. The comparison is totally wrong.

In the real world, both have a place. The issue is one of choice. Do you run a corporate network that provides the infrastructure for your international business on lightweight technologies or do you run them on standards that the carriers use for global networking? Or, as in the real world, do you use a mixture of the two? In the latter case, which type of technology governs the addressing schemes and IT policies of your organisation? Limited proprietary schemes or internationally defined schemes?

IP Address Limitations

The full set of four-byte IP addresses have not been fully assigned by the Internet group and there is room left for more addresses. This limited address field has, traditionally, been seen as the major restriction in creating a truly a global IP network. But as the Internet becomes more popular, more users of IP networks will have to register. My guess is that probably only 15% of the IP technology users are in fact registered with the Internet and are using unique IP numbers (addresses).

Let's take a look at what might happen if the Internet does become the global network its proponents envisage. If all the IP users across the world did in fact register for unique addresses (with only four bytes) there is unlikely to be enough address space for them. Of those users that did successfully register, many would already be using default or random IP addresses in their networks.

Figure 1: A Numbered Based System

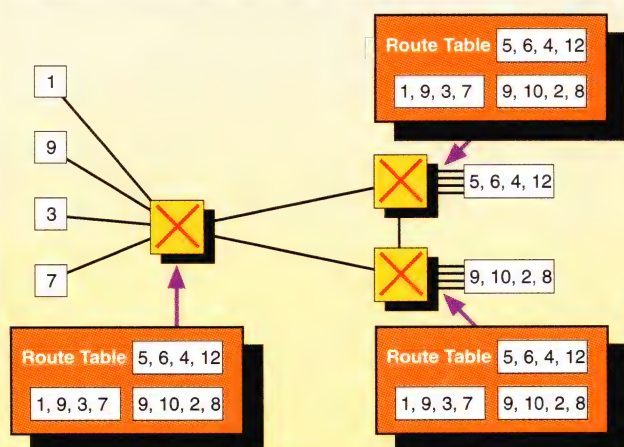
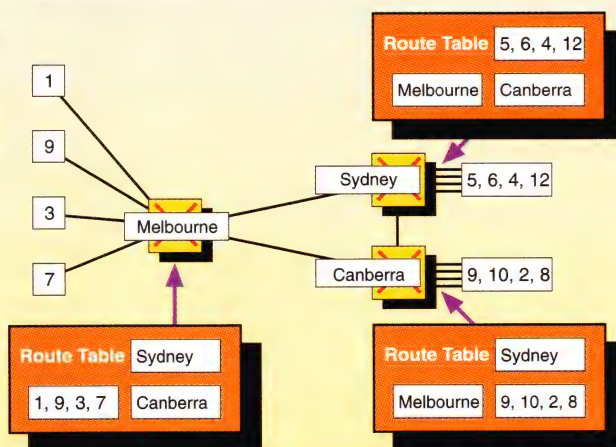


Figure 2: A Geographic Based System



They would have to reconfigure all these addresses to use their assigned address — hardly a trivial task. Those who could not get an Internet space would have to either run a closed network or run the scalability gauntlet.

Two solutions are proposed to combat this four-byte limitation. The first is to use the Simple Internet Protocol (SIP), which provides an 8-byte addressing scheme. The logic of moving to an 8-byte address is to enable the network to expand to a 'global' scale. But SIP is a global disaster waiting to happen.

The reason is because of the way IP nodes are set up. Figure 1 shows a basic network with three major routing nodes, each with four end nodes attached. Because the IP address format is actually a number administered according to network size and because the number is randomly assigned (the next registered user from anywhere gets the next number), each node's route table needs to have explicit references to the networks or nodes it wishes to reach.

In Figure 1, where a node is added to the network, all the route tables in each node need to be administered. This function is usually performed by routing protocols such as RIP, or by manual configuration. However, as the number of nodes across the network increases, the routing protocol traffic to keep the tables maintained must increase. In a worst case scenario, this traffic would grow exponentially as the node count increased. As each node is brought on or off line, route information may be sent to all other nodes and between all other nodes. In practical situations, this must be controlled. By the way, RIP was originally designed for networks where it was considered that route table updates should occur every minute or so.

The IP address form is a network or node reference, not an address. Addresses dictate where things are. They relate to geography and location, in terms of countries, states, cities, etc., not a network size or its number.

If an 8-byte randomly allocated number were to be used for a global IP network 'addressing' scheme, the major switching nodes might need a route table of gigabytes because a node that is connected to a network containing billions of nodes whose addresses are configured in an unstructured way will require complex route tables. When routing packets through the node these tables will take much longer to search than structured route tables. We will have a situation where the efficiency and speed of a node is affected by the structure and range of its addressing scheme and the way in which network addresses are allocated and administered.

More importantly, if an 8-byte addressing scheme is used, the routing protocols needed to dynamically administer the route tables in every node in the worst possible case (i.e. millions of nodes continually updating millions of nodes) would make the network a global fireball!

There is little point in using an 8-byte scheme unless one wants to have a very large interconnected network with the possibility of many millions of nodes! Would such a network work? There is an apocryphal story about a proprietary network architecture where it was said that to add a node one had to switch the whole network off! With lightweight technologies such as IP, are we heading for a

point where to add a node to a network could cost millions of dollars just to broadcast routing information?

Now look at Figure 2, which shows a geographic/structured addressing scheme. If a node was added to the Melbourne node, only the Melbourne node route table would be updated and little routing protocol traffic would have to be exchanged. The network is designed and addressed on a geographical, connectivity and traffic distribution basis, just as the telephone network. It is not as a numbered network randomly attached to other numbered networks.

That is why a second solution is to replace IP with OSI CLNP which carries 20-byte ISO structured addressing schemes. However, this means that 'OSI' is being used to resolve a major networking problem, which OSI critics might have trouble accepting.

Avoiding Addressing Brick Walls

These addressing problems are theoretical and worst case. But one should look at IP addressing and ask if the proposed solutions cure it, or make it a larger problem that has no cure.

Expanding a network to a global scale has other major implications for ownership, security, billing, reliability, fault management, customer service support, etc. The proponents of TCP/IP and the Internet seem to say that because a protocol is easy to implement, is widely used, and is already a worldwide network, it can automatically become a reliable, scalable, global network that can be used for commercial services. My view is that TCP/IP will go some way toward this, but unfortunately both the protocols, the network operational requirements and the laws of physics do not make it an alternative to carrier-provided services.

That said, an IP network does provide a very useful and accepted level of service and does use simple low cost protocols. However, the OSI-based telephone network, the X.25 network, the ISDN network and the emerging X.400 messaging network all use structured addressing schemes, they all work across the world, they all scale and they do not need megabytes of dynamic routing information. They all have been defined and ratified by the carriers and the world's recognised standards bodies.

The evolution of the Internet is being seriously reviewed. I have no doubt it will move toward (OSI) CLNP and OSI NSAP addressing schemes. But the major issue for business is the choice of the protocols and addressing schemes used and the levels of services provided. To head down a path that ends in brick walls of network addressing, connectivity and traffic problems with a thousand nodes already installed is highly undesirable.

Unfortunately, for those scaling up their 'distributed' networks, these walls are now appearing. And, there are more important issues, such as the fact that users of such networks have little or no security, no resource measurement and accounting facilities or the type of service support needed to diagnose and remedy 'global' network faults. As ever, the best advice is: 'The first action of any network design is to determine its naming and addressing scheme.'

Alan Lloyd is Strategic Developments Manager for Datacraft Australia Ltd (Melbourne, VIC).

Tn3270 from page 26

of reasons. First, the FEP typically is doing both server and client work; as the number of connected users goes up, the FEP runs out of processing power, and response times balloon. Second, installing client software at the FEP causes traffic on the TCP/IP backbone to increase considerably, since every keystroke from a user terminal is sent over the network individually and is echoed back (ASCII terminals are inherently full duplex). If the user is at a remote site connected through a router

and a low-speed WAN link, performance can be affected drastically.

The main advantage to putting Tn3270 client software on FEPs is that it offers a single point of control for managing Tn3270 links. Fewer copies of client software are needed, making the installation inherently easier to manage.

One alternative to running Tn3270 client software on FEPs is to run it directly on end-user PCs and workstations. This setup offers optimal performance, since the end-user station has more than enough process-

ing power to handle the emulation and protocol work. The downside, of course, is lower manageability and higher cost — Tn3270 client software and TCP/IP protocol stack software has to be installed on each machine.

Terminal Service

A third alternative — one that fits between FEP-based clients and PC clients in the Tn3270 cost-benefit trade-off scheme — is to run client software on terminal servers (see Figure 2B on page 44). These devices

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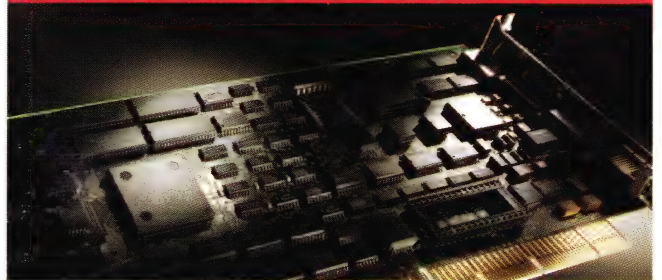
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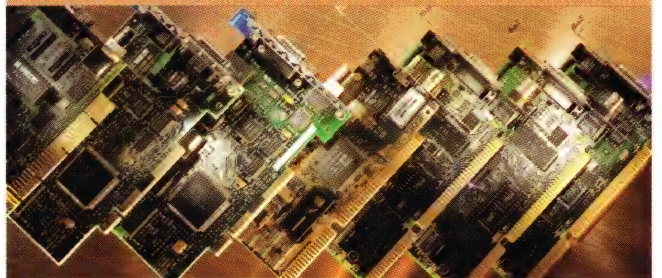
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Figure 2A: FEP-Based Client and Server Tn3270

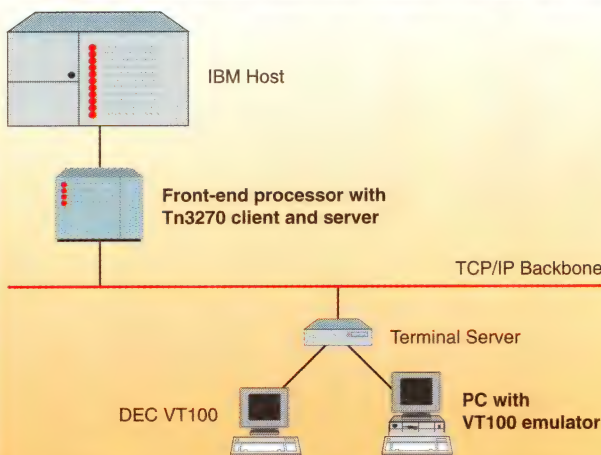
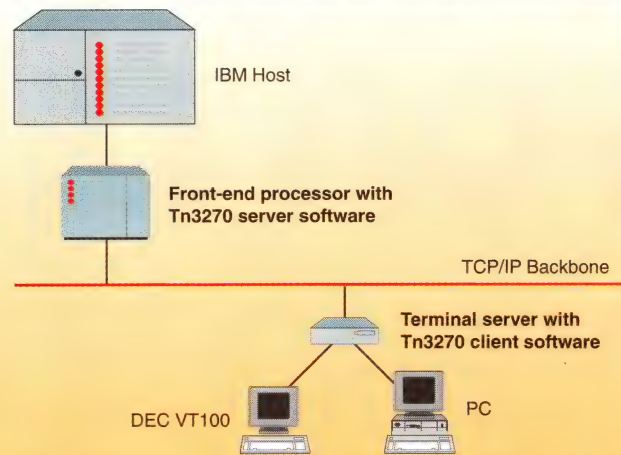


Figure 2B: Terminal Server-Based Tn3270



Placing Tn3270 client software on a front-end processor (A) makes Tn3270 easier to manage, but it can exact a high performance penalty, since requests from end nodes must be sent over the backbone one keystroke at a time. By moving client software out to a terminal server (B) or to individual PCs, performance perks up.

connect to VT100 terminals and PCs emulating VT100 terminals via serial connections or dial-up asynchronous lines.

Tn3270 clients based on terminal servers offer better performance than FEP-based clients. Typically, terminal servers handle anywhere from eight to 20 users, which means processing power isn't overwhelmed by user demand. What's more, the server component of Tn3270 software still resides on FEPs or the host.

Tn3270 terminal server performance may not be as sharp as PC-based clients provide, but terminal servers offer some clear advantages. One is manageability: since terminal servers are part of the network infrastructure, network managers can exercise more control over them. Some terminal servers are outfitted with standards-based management protocols, such as SNMP, enabling them to be managed easily from a central console.

Another key advantage is flexibility: Terminal servers provide access to other hosts, such as Unix computers and DEC VAX systems. Putting Tn3270 client software on terminal servers gives users another avenue for host applications. If client software is loaded onto individual PCs, each PC would have to be equipped with emulation software for each type of host.

Robust Emulation

The most complex part of Tn3270 is the client software, which determines the quality of the terminal emulation session. The more robust a session is, the more functionality is supplied, such as the ability to customise key assignments that enable a VT100 or PC keyboard to emulate a 3270 keyboard.

The task a Tn3270 client performs is difficult because 3270 terminals are more complex than many other types of terminals. Back in the 1970s, IBM developed 'in-

telligent' (also called block mode) terminals to offload tasks like terminal I/O from the mainframe. The mainframe sends commands to the intelligent terminal, telling it where to display input fields and headings. The user then fills in the data requested.

The terminal's built-in intelligence also enables a user to make changes on a screen without involving the mainframe. (With dumb terminals, every keystroke is sent along the network to the host.) When everything on the screen is correct, the user hits the 'send' key. To minimise the mainframe's involvement even further, only the changed fields are sent back across the network.

Along with this, a Tn3270 client must provide the ability for users and network administrators to customise keyboard mappings to accommodate individual PC users' preferences, and, in the case of client implementations in terminal servers or FEPs, to allow different types of ASCII terminals to be configured according to user preferences (not all ASCII terminals are constructed the same). The associations between 3270 keystrokes and keystrokes on asynchronous terminals or PCs usually is handled via an ASCII-to-EBCDIC table. This table, which can be configured by users or administrators, maps outbound host EBCDIC data to characters that can be displayed on ASCII terminals and PCs (which also use ASCII).

Client software that resides on terminal servers or FEPs must also accommodate screen handling for individual terminals. Screen handling includes the specification of the sequences that provide such functions as cursor movement, screen clearing, highlighting, and entering and exiting 132-column mode. Extended attributes that may be supported by the client include sequences for cursor blinking, reverse video, and underlining. On terminals capable of displaying colour, some Tn3270 client soft-

ware lets users configure the sequences for four or seven-colour display.

PC-based clients are most adept at screen handling. PCs have the power to perform conversions, and their bit-mapped screens afford the most flexibility in emulating IBM terminals for enhanced features like graphics display. FEP-based implementations are least adept, while terminal servers fall between FEPs and PCs.

With interest in Tn3270 now picking up, efforts by the IETF to develop a formal, more comprehensive standard are getting more attention. The first and most fundamental task being worked on is to come up with a single standard for the Tn3270 handshaking process, which now accounts for most interoperability problems.

As part of its Tn3270 effort, the IETF is developing a way to allow a terminal connected via Tn3270 to request communications with a specific device, such as a printer. Full support for 3270 printing (under the Tn3270 specification) is also planned.

Finally, support for the 3270 ATTN and SYSREQ keys and SNA responses are being developed. The ATTN key gets the attention of the application while it is running; the SYSREQ key gets to the operating system, bypassing the application if necessary. While most 3270 function keys can be emulated, these two present special problems because they use special characters.

Unlike previous work, the current push to define Tn3270 in more detail has widespread vendor support. Timely completion and implementation should make Tn3270 an even more competitive alternative to other SNA internetworking schemes.

Michael Procopio is Vice President of Technical Marketing and Doug Potter is Senior Engineer at Xyplex, a US-based maker of routing hubs.

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LAN/WAN ANALYSER



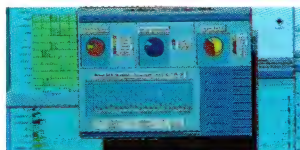
LAN: Token Ring
ETHERNET

WAN: ISDN
FASTPAC
AUSTPAC
TRANSEND
DDN
SNA

PROTOCOLS:

X.25, SNA, HDLC,
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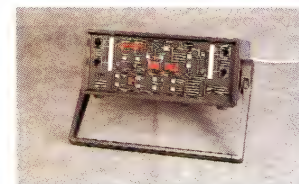
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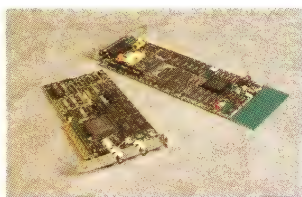
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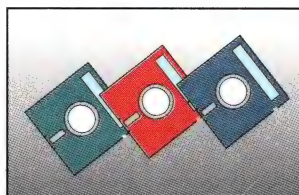
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Madge's New Hub on a Card

Sliding Madge's Hubcard into a NetWare server allows network managers to set up and manage small Token Ring sites.

For network managers who need to build Token Ring LANs at branch offices but don't have a lot of extra cash to toss around, Madge Networks now offers a cost-effective alternative to the high-end modular hubs on the market. Its new Smart 16/4 AT Hubcard, a five-port manageable Token Ring hub, links up end-nodes for approximately \$180 per port. This figure compares favourably with something around twice that figure for the pricier modular hubs.

At the other end of the spectrum, the Hubcard competes with low-end stackable hubs that also are aimed at connecting small sites on a shoestring. If managers wish to forego SNMP in order to balance their networking budget, the stackable hubs actually cost somewhat less than Madge's card — but the price increases significantly when the hubs include management.

The Hubcard from Madge Networks slots into a Novell NetWare server and supplies five RJ-45 ports, plus splitters that allow each port to attach two stations (for a total of 10 stations per card).

To increase a Token Ring's capacity even further, up to six Hubcards can reside in one file server — providing users with a total of 60 connections.

In a configuration like this, the cards are daisy-chained using short drop cables. The Token Ring is connected in a star topology using unshielded twisted pair (UTP) cabling. The downside to this type of scheme is that the server becomes a single point of failure. If it goes down, it takes the entire network with it.

Management and More

The card supplies an SNMP agent, allowing it to be controlled from SNMP management systems such as HP OpenView, IBM NetView/6000 and Sun Sunnet Manager. It can also be monitored from a PC running Novell's NetWare Management System (NMS). NMS provides a Windows-based graphical user interface that allows management of NetWare file and print services, as well as Madge's card. The Hubcard also features automatic fault recovery to keep the LAN up and running, and security features to keep out would-be network intruders. Additionally, the hub can work with other devices in the server to supply end-to-end connectivity with the corporate network.

To maximise network uptime, Madge had loaded the Hubcard with fault-recovery capabilities. For example, the card automatically detects and isolates beaconing nodes to prevent a faulty station from crashing the LAN. It also notifies the central management console of the problem. Madge says this solution is particularly useful in branch office sites with no MIS or technical staff on hand, allowing remote users to continue working while a technician dispatched to rectify the problem is en route from the central office.

The Hubcard provides two methods of keeping unauthorised users off the LAN. First, net managers can grant access rights to each media access control (MAC) address on a port-by-port basis; unapproved addresses are held off the net. Second, managers can configure the card to disable in-

PRODUCT SUMMARY

Name: Smart 16/4 AT Hubcard

Description: Token Ring hub on a card that slots into a NetWare server to connect up to 10 stations

Price: \$1,803 (ex. tax)

Vendor: Madge Networks

Distributor: DDP Pty Ltd, 77 Southbank Blvd, South Melbourne VIC 3205
Tel: (03) 694 6711

dividual ports at specified times of day (for example between 5.00pm and 9.00am) to prevent stations from attaching to the network outside normal office hours.

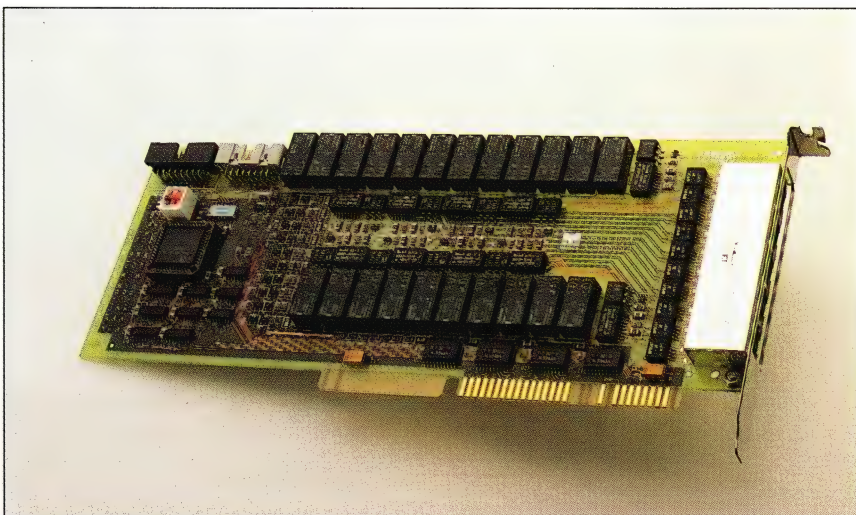
End-to-End Integration

While connecting end-nodes to a Token Ring LAN is the Hubcard's primary function, branch offices also need other types of connectivity; remote sites require a physical interface for a wide area link to headquarters and they need a bridge or router to direct traffic between the LAN and WAN domains. Madge kept this (along with crowded data centres) in mind when designing its Hubcard. In order to give branch offices access to resources on the corporate net, managers can team the card up with additional hardware and software.

For example, to route IPX traffic (and bridge other protocols) between the remote and the central sites, the Hubcard would work with three other components loaded into the NetWare server; Novell's Multi-Protocol Router (MPR) Version 2.1 Plus software, which routes IPX traffic; Madge's Smart 16/4 Bridgenode Token Ring Adaptor, which bridges all other protocols; and a third party WAN adaptor.

Alternatively, to shuttle SNA traffic that emanates from NetWare nodes emulating IBM terminals between branch offices and the central site, the Hubcard is able to work together with four other devices: Novell's NetWare for SAA, an SNA gateway that supports 16 SNA sessions; Novell's SNA Links, software that transmits IPX management traffic over SNA; Madge's Smart Ring Node, a Token Ring adaptor; and a third-party WAN card. Madge's Hubcard is certified by Novell for integration into NetWare environments.

Stephen Saunders



HP's No-Frills LAN/WAN Analyser

The new J2300A protocol analyser delivers the basic functions net managers need without costly features they don't want.

Despite the never-ending rush of internetwork management platforms vying desperately for their attention (not to mention their budgets), many corporate network administrators have resisted the newfangled in favour of tried-and-true protocol analysers. But the costly and feature-rich analysers targeted at product developers miss the mark with managers who don't want to lay out a lot of scarce cash for capabilities they won't use.

Stepping into this gap in the market is Hewlett-Packard's new J2300A protocol analyser, which delivers a feature set more appropriate to the task at hand — along with a palatable price. It should appeal to net managers looking for solid 2Mbps WAN performance and LAN troubleshooting but without the fancy features (and fancy price tags) of lab instruments.

The J2300A captures data at full speed on T1/E1 wide area network links and Ethernet and Token Ring local area networks; decodes WAN protocols to 2.048-Mbps and encapsulated LAN protocols; performs statistical analysis of internetwork traffic; displays breakout data pertaining to the unit's network connection; and provides a built-in BERT (bit error rate tester) which can perform error checking for bit errors, block errors, errored seconds and G.821 results. What's more, the unit incorporates the expert system capabilities found in Hewlett-Packard's Network Advisor LAN analysers.

HP's Network Test Division has packed all of these features into a 'ruggedised' PC that weighs in at around 6.4 kilograms and measures just 30 by 8.5 by 29cm. The wide area network-only version of the unit costs \$17,700, while a fully loaded unit with

Ethernet and Token Ring LAN and WAN capabilities costs \$41,500.

Additionally, the analyser can be monitored and controlled from a window on the HP OpenView internetwork management platform, enabling users to oversee a connection at a remote site or at a local node from the same console.

By bringing together only the features net managers need, and selling its unit at a reasonable price, Hewlett-Packard has carved a niche for itself in the competitive protocol analyser market.

It's true that the J2300A lacks the dual-port testing capabilities of some rivals. This means that the unit can't simultaneously test both sides of routers and other devices that connect LANs and WANs. Additionally, the HP device can only analyse one connection at a time, although it is able to capture WAN packets while the LAN analysis is displayed on-screen.

Building On Success

HP has built the J2300A from several of its most successful test components. The basic WAN-only unit is a specially constructed 486-based PC with HP's 4959B T1/E1 protocol analyser slotted in. (HP offers a free upgrade to the J2300A for current owners of the 4959B.) Either an E1 or T1 card comes as standard; networkers who need both T1 and E1 can add the other interface by purchasing a special module and adaptor.

The unit can accommodate up to 32MB of capture buffer. When users buy the unit, they can opt for a 2MB buffer at no extra charge or a 30MB buffer that adds \$4,300 to the cost. Those who foresee the need for more memory should add it sooner rather than later; installing another 30MB requires a trip to an HP service centre.

The unit's wide area connection works with a wide range of interfaces, including EIA-232, RS-449, RS-442, RS-423, V.10, V.11, X.21, V.35, V.36, and T1/E1 or fractional T1/E1.

The J2300A decodes X.25, ISDN, and frame relay WAN protocols and LAN traffic encapsulated in X.25, frame relay, and PPP (point-to-point protocol). It also handles the headers used by routers from Cisco Systems and Wellfleet. It is able to look at encapsulated IP and IP Broadcast, IPX, DECnet, LAT, AppleTalk, SNA and SNMP LAN protocols. Traffic statistics are displayed for all the protocols the unit decodes, and it breaks out IP traffic and services by type.

PRODUCT SUMMARY

Name: HP J2300A LAN/WAN Analyser

Description: A rugged portable LAN/WAN protocol analyser geared to managers of corporate networks

Price: (Excluding tax) The HP J2300A Series basic WAN unit with T1 or E1 adaptor is priced at \$17,700. A LAN module with an Ethernet adaptor costs \$17,700; a LAN module with both Token Ring and Ethernet is priced at \$24,800

Vendor: Hewlett-Packard, 31-41 Joseph St., Blackburn VIC 3130 Tel: 13 13 47

The WAN unit also features the ability to log statistics to the unit's hard disk or to a printer; virtual remote control and PC data analysis; voice channel access; customisable data/decode displays and statistical analysis; and more than 150 pre-written tests for all major protocols.

Not for WANs Only

In order to add LAN troubleshooting to the J2300A, users bolt on a LAN module fitted with specially designed adaptor card versions of the Network Advisor. Cards are available for Ethernet (the J2260A) or for 4/16Mbps Token Ring and Ethernet (the J2261A). Both versions perform seven-layer decodes of TCP/IP, IPX/SPX, AppleTalk, Banyan Vines, DECnet, XNS, SNA, and OSI LAN protocols.

The LAN module's expert system includes the Network Commentator, which analyses IPX, TCP/IP, and Token Ring statistics and displays data such as available server memory. It also includes the Fault Finder, which isolates network problems and suggests remedial actions.

Performance features include simultaneous execution of measurements, graphical display, built-in help, and also a customised windowing user interface.

The HP J2300A can also simulate X.25, ISDN, and SNA protocols. Users can incorporate the simulated traffic into a scripting language to create routines that respond to certain alarms.

For busy network managers who need to quickly and efficiently analyse WAN and LAN protocols in a multi-vendor environment without bells and whistles they'll never use getting in the way, the HP J2300A could be just the ticket.

Mary Jander



Bringing Remote Offices On-Line

The ISIS range of ISDN adaptors simplifies the problem of providing branch office access to the corporate WAN.

Every network support specialist, administrator and designer in Australia has a common nightmare: trying to incorporate its branch offices into the company network. These offices are often very small, don't justify the cost of an expensive bridge or router or anything but the lowest bandwidth leased line and staffed by employees with few networking skills.

The effect of this situation is easy to see. Walk into any small branch of a bank, building society or health fund and you will find character-based terminals and very few PCs. If you look in the back corner of these small branches you will find some combination of a multiplexer and/or a modem — telecommunications via analogue technology. The irony in this is that at present around 85% of Telecom Australia's business customers are able to do away with analogue signals by using ISDN. This simply means replacing a modem with an NT1 (BRA) or an NT2 (PRA) and a terminal adaptor. The problem been the cost and complexity of this equipment.

This problem has been neatly solved by the ISIS product range from UK-based KNX. ISIS is distributed and supported in Australia by Network Designers KNX who are actually co-owners of the UK company which gives them more than sufficient input into the design process to look after local users' interests. The current ISIS range consists of the ISIS-X (an ISDN BRA interface), ISIS-D (a DDS/modem interface for areas

where ISDN is not available), ISIS OPAL (an 802.3 NIC), ISIS Encryption (providing multi-channel DES encryption with double key option) cards and three software packages for workstations, ISIS Access Servers and an ISDN-to-X.25 workstation.

All ISIS cards are intelligent adaptors which are supplied with NDIS and ODI drivers. This allows them to appear as ordinary network interface adaptors to common network operating systems. For example, two Windows for Workgroups workstations, at physically remote sites, equipped with ISIS-X cards can use the PSTN as if it were an Ethernet cable system.

Like bridges, ISIS cards act at the MAC layer so protocol choice is irrelevant. Even broadcast intensive protocols can be used cost effectively due to ISIS's Tollsaver mode in which the ISIS software — Workstation and Access Server — 'spoofs' (i.e. provides local responses to) such things as 'keep alive' packets and passes low bandwidth data such as SNMP traffic, unspoofable broadcasts such as NetBIOS over IPX and low bandwidth X.25 traffic over the ISDN D channel.

With the release of the ISIS Workgroup Access Server, environments such as Windows for Workgroups and Novell DOS 7.0 which offer full 32 bit protected mode operation, will be able to act as Workstation and Access server concurrently. This means that small remote LANs can be bridged by ISIS into a single large LAN with the link

PRODUCT SUMMARY

Name: ISIS

Description: ISDN basic rate adaptors for PCs and servers

Price: (RRP inc. tax) ISIS-X ISA \$1,450 or MCA \$1,850; ISIS-D ISA \$1,450; ISIS OPAL ISA \$1,280 or MCA \$1,680; ISIS Encryption Card ISA \$1,890 or MCA \$2,290; ISIS Workstation Software (single user) \$1,342 (5 user licence expansion) \$880; ISIS ISDN to X.25 Workstation Software (single licence) \$500; ISIS Access Server Software (single) \$2,690 (single licence expansion) \$1,250; ISIS Workgroup Access Server Upgrade \$800

Vendor: KNX

Distributor: Network Designers KNX, Level 9, Swann House, 22 William Street, Melbourne VIC 3000 Tel: (03) 629 3800

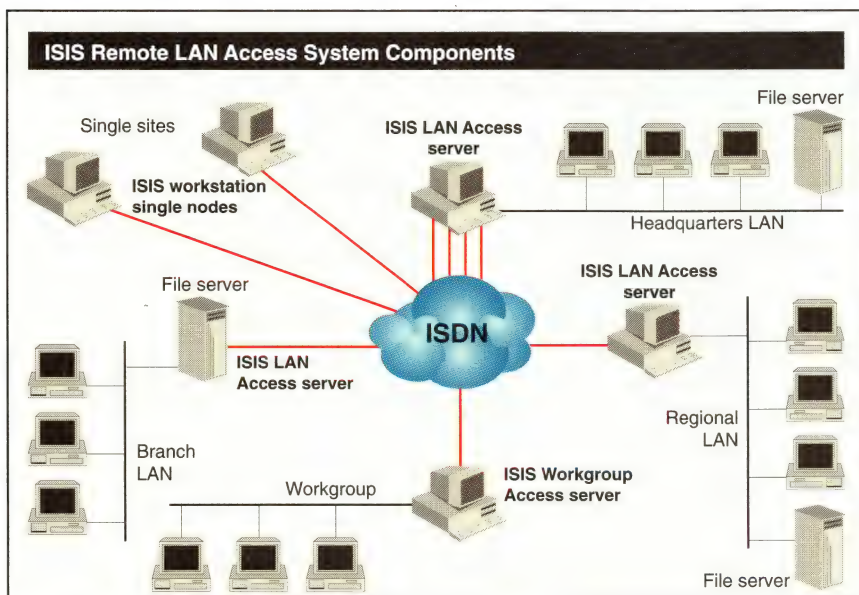
provided by ISIS transparent to users and without a separate gateway platform.

Where a separate platform is either required or advisable Network Designers provides the ISIS Access Server which consists of one OPAL card and one to four WAN interfaces (ISDN or DDS) and is a simple bridge. The Access Server would also be deployed at larger sites as a concentrator which would allow small sites and single remote users access to an enterprise WAN backbone managed by traditional routers. When ISIS's Access Server User Identification option and DES Encryption options are added to the base Access Server this topology is probably more secure than the average corporate LAN, let alone WAN.

The ISIS range is extremely appropriate for Australian conditions. Aside from providing cost effective data communications ISIS workstations support concurrent data and telephony — making telecommuting practical. Future products, such as a Primary Rate Adaptor interface card (the ISIS-X30) and a version of the ISIS-X card which supports four BRA interfaces will change significantly the cost/benefit equation of remote networking. For example, the 2Mbps bandwidth provided by the ISIS-X30 may make cross-WAN backup of remote servers cost effective.

In summary, the ISIS range represents a completely new class of network product, one which presents a number of new opportunities and solves a number of problems.

Graeme Le Roux





Tom Amos

Overseas and Out

With two carriers competing for business the Christmas and New Year telephone traffic rush this time round had a slightly different flavour than in previous years. This was great news for the Australian consumer but maybe not so great for the overall economy.

I have been intrigued by the ebb and flow of the licensed carriers' advertising campaigns regarding international traffic, not so much in the competitive nature of the industry that is evolving, but in the dynamics that underlie the offers; dynamics that go to the very heart of the international business and the issues of efficiency and cost-related pricing. Even with the spot discounts, have you ever wondered why it still costs so much to make an average overseas telephone call when prices in Australia have, under competitive pressure, fallen in some cases to 10 cents per minute for any destination within Australia. One would expect that international prices would fall in line with the overall reduction in domestic tariffs.

International telephone traffic is normally a two-way business with the delivering country operating the outbound and the terminating country (the place where the telephone call ends) charging for the call delivery. Simple arrangements built up in a continuing cartel environment over a number of years have ensured that the deals between countries gravitate towards development of reciprocal traffic delivery systems, because without the return traffic the more calls that are placed from the originating country, the more is the cost of the settlement. Competition distorts this arrangement.

Any call that originates in Australia has a number of components that comprise the end-to-end costs per minute. For example, there is the local access cost of 25 cents for the originating call into the international system, the transmission access component that is regulated by the international cartel and finally the cost of termination, less the volume discount for terminating a lot of traffic. Although there are hundreds of destinations, the majority of traffic goes to less than 20% of these. The Australian access and transmission component is easily calculated and all up the latter represents less than 10 cents per minute, even on a fully allocated basis.

So where is the rest of the say, on average, \$1.50 per minute going? Surely not into the terminating charge at the distant end. If the distant end charged the same as Australia then this would mean there was, for the average call, about \$1.25 per minute to either offer as discounts or contribute towards other minor settlement costs and to the overall running costs of the carrier. Remember that cost structures in international carriage have reflected the same trends as those in the national arena because the technology and basic building components are essentially the same.

To balance the dynamics consider the situation where the local market is stimulated to make calls in an attempt to divert market share. If the stimulation results in a change in balance between the outgoing and incoming traffic then the cost of terminating the calls in the foreign destination may far exceed the money collected from terminating the calls that return. A traffic imbalance . . . so what!

The general natural international traffic flow matches the wealth of the countries involved and there will always be destinations that are subsidised by receiving more calls than they return. This is due to a myriad of factors but the aim in every case is to try and terminate as many calls as possible. Discount subsidies that are now being promoted thus appear to come from the originator's (licensed carrier) half-circuit revenue and the volume termination agreements.

With the arrangements already in place it is hard to understand why any carrier in receipt of monopoly profits would wish to stimulate the originating traffic unless there was a corresponding promotion in the target destinations to attract reverse traffic — a two-way stimulation. One-way is counterproductive to the settlements system and significantly erodes the route-by-route profitability unless the super profits are so great that the volume increase outweighs the termination loss or there are other competitive reasons.

The ownership of the destination carrier has certainly a lot to do with the overall traffic route profitability. The volume discount spiral bites both ways. If, in a traffic route a carrier enjoys a termination volume discount, then the reduction in volume due to traffic migration has an impact not only on the settlement per call terminated but on the amount of money available per call for the termination payment. Less traffic means more terminating costs unless both ends are owned by the same carrier. On some routes this is already the case for Optus and to a lesser extent also for Telstra. The stimulation thus has a sharp edge in that if you over-stimulate but the traffic is carried by someone else then the penalty for loss can be quite severe on your existing traffic.

In the licensed carrier area competition on the delivery of international services can take many forms and whilst the discounts flow, the consumer wins. But if there are non-reciprocal promotions in the target destination countries then a large portion of the money collected in Australia for the service provision will flow overseas to settle the delivery account. Hardly a desirable outcome. There is obviously a need to have reciprocal promotions in the other countries if there is not to be a drain one way.

Are we thus seeing spot discounts in the international area for all the wrong reasons and token discounts that are still far below that possible? Given the super margins that are available in the international business, what the consumer may be witnessing is a termination traffic war to determine who gets the volume terminating discounts prior to a real discount campaign.

It would be ironic if most of the marginal profit that resulted from the stimulation of the Australian international market was exported. The rationalisation of trade in services still has a long way to go even after the recent GATT deals. Roll on international resale because as it stands the current system appears to reflect a suite of artificial trading arrangements rather than the true costs of service provision.

Tom Amos is a partner with telecommunications consulting engineers Amos Aked Swift.



Richard Butler

Convergence Will Drive Spectrum Allocation

Telecommunication by its nature has an international character demanding varying degrees of cooperation within and without countries to assure harmonisation of actions for effective development and operation of networks, systems and services. Indeed this led in 1865 to the establishment of the International Telegraph Union, which with technological advances and restructuring (including consolidation with radio spectrum functions) became the International Telecommunication Union.

Countries have virtually been obliged in many ways to assure cooperation for delivery of services by the various electronic media, be they by cable, wire or wireless applications. Avoidance of technical interference has been one critical factor in cooperation to assure system performance and inherently protection of investment. With the exception of only very few countries, most of the service delivery and use of the radio spectrum and outer space orbits has been organised through applications directly controlled by Government or publicly-owned utilities. Even for the exceptions, the major uses have been for Government-type functions and services.

For many decades these features facilitated fulfilment of central Governments' international treaty obligations and responsibilities to negotiate change and, importantly, assure orderly implementation of regulatory treaty decisions. They do not contain sanctions; relying on the settlement of disputes largely by consultation, if necessary via diplomatic channels. This seems to have worked for many decades with spectrum use being largely put into place by procedural provisions within planning limits and principles set out in the international regulations of treaty status. Hence there has been a huge amount of mutual recognition and self regulation within the framework of the regulatory provisions of the Radio Regulations which have treaty status.

Spectacular is the growing impact of digitalisation in driving convergence between services and a many new applications. It is digitalisation that provides a core stimulus to globalisation, rationalisation of information sharing, organisational and business efficiency and economic and service performance. At hand are significant convergences between data/information flows with ever-increasing two way telecommunication systems. They open up many innovative service opportunities — from wireless connectivity within the local loops so far dominated by wire connections to the global outreaches to assure personal communication and information exchanges in all forms from anywhere to anywhere. We will see acceleration of private investment capital, leading to new players, new services, new markets and an ever-increasing range of wireless connections and uses of the spectrum by these categories of interests.

Nowhere is this more evident than in the future orientations in the Asia-Pacific seeking availability and use of the radio spectrum for new and privately financed wireless connections and systems. They include the major openings for new digital terrestrial and satellite mobile and broadcasting applications as a result of the World Administrative Radio Conference 1992 (WARC '92).

The spectrum has taken on greater quality and economic values. In an era of competitive performance and user pays, values extend to corporatised service utilities for broadcasting, television, cellular mobile operations and fixed private networks and systems for which ownership turnover has regularly occurred in some countries over the years. In the last decade the gains for a few were spectacular. From a wider public perspective they put the spotlight on the need for new class of licence arrangements and fees beyond the more traditional recoverable cost of administration concepts.

In a few cases this has resulted in additional licensing options towards some form(s) of a market-based approach. The *Radiocommunications Act 1992* is one example. However from discussions in the recent CIRCIT Conference 'National Spectrum Management: Policies and Strategies for the 1990s and Beyond,' it would seem that the actual market-based conditions are unlikely to be put in place for sometime yet. The potential impact on future international considerations will also have to be fully explored and understood.

Infrastructure inadequacy, huge populations without even sufficient quality one-way reception and growing commercial trade and services, all lead to opportunities to seek to provide communication, information and video access. This has led to entrepreneurial activity for the planning of multi-country coverage satellite systems for service in the Asia-Pacific. Some can extend to parts of the Middle East and Europe. A number are virtually competing for the same nominal orbit positions and moreover in significant numbers that cannot be sustained within existing radio frequency allocations and existing technology. Doubtless with such uncertainties finance procurement will be inhibited. Some may be by-passing existing agreements and the situation can be exasperated by the ability now to arrange in orbit satellite transfers quickly to new locations.

Some parties have reached agreements during the coordination phase including co-location and orbit sharing, and thus can proceed confidently for procurement. Others continue in apparent conflict. It seems that for one or other reason parties affected have not invoked all the planning provisions introduced by WARC '88 to respond to the principle of assuring 'equitable access in practice' to the spectrum and in particular progress through the multilateral planning meeting concepts between the parties concerned.

Thus uncertainties still remain and either some rationalisation of alliances and projects proceed or the matters could result in considerations in an upcoming World Radiocommunication Conference. This could include also spectrum allocation review — in particular between fixed satellite service and the broadcasting satellite service conditions to recognise the need for greater recognition of multipurpose satellite use from the same orbit position in say the Ku band, taking account of both technology advances, convergence and economic deployment of resources.

Richard Butler, AM, was Secretary General of the International Telecommunication Union, 1983-1989.



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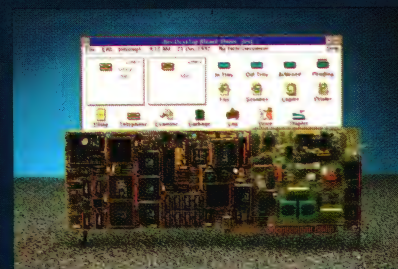
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Brian Finn, AO

Chairman, IBM Australia

Chairman of IBM Australia and a member of the Telstra Board, Brian Finn is one of a select group of business leaders with direct involvement in both the IT and communications industries. He joined IBM UK in 1959 and worked for the company in the US and Asia before serving for 13 years from 1980 as CEO of IBM Australia. He is Chairman of the Australian National Training Authority and the Interim Council of the National Science and Technology Centre; a Board member of the National Mutual Life Association of Australasia; and a Fellow of the Australian Academy of Technological Sciences and Engineering and the Institution of Engineers, Australia. He spoke with Liz Fell at the new IBM Centre in Sydney.

How important is it for Australia to build what's become known as an 'information superhighway'?

Finn: I think we're headed towards a time where the technology really needs broadband communications. If you look at computing technology, the way it is moving and the way that people want to use it, you need a better communications capability than you get from today's local area networks. I think it's important for Australia, and for everybody, to respond to that because it offers facilities, and it offers business opportunity in the competitive advantage sphere. Whether that's the superhighway, we can spend a minute on what you mean.

AC: I borrowed 'superhighway' from the US where it's used to refer to Clinton's policy initiatives. Would you agree Australia is taking the lead from the US in some sense?

Brian Finn — A Sceptical Technologist

Finn: No. There's nothing that gives me that sense. If by superhighway you mean this kind of worldwide ability to converge information and communications, I think that will be a natural technological evolution. Many of the things that are talked about in the area of multimedia and 'edutainment' (a word that people have coined for a mixture of education and entertainment) I'm somewhat sceptical of — certainly in the short-term, through to the year 2000.

AC: Why are you sceptical?

Finn: I'm sceptical because there are some technological issues. For example, to store the average movie takes about two gigabytes of information. If you look today at American Airlines, which has an extremely large database to run airlines and travel, they probably store somewhat less than 150 gigabytes of information. So we're not there yet. The other thing is that we technologists have continually over-estimated public willingness to embrace technology.

Probably most of us statistically have videorecorders, we certainly have TV sets, and an increasing number of us have PCs. But I believe most families probably do not use their videorecorder other than to press 'play' and 'rewind.' That's about the limit to which they want to get involved in that very simple technology. It doesn't matter what the technologists think. People aren't interested, they don't want to know. So this issue of convergence technologically is possible. The big unknown is the extent to which the public wants to buy in.

AC: In the multimedia home, will consumers opt for a computer, a TV or both?

Finn: My opinion is that it will be both for most people quite separately.

AC: So the integrated multimedia terminal we hear so much about may not be the answer?

Finn: Well, I'm old now and maybe I've lost the plot. But why don't you put a \$2,000 computer in your \$200,000 home to drive all your electrics? It's not a terribly expensive add-on to the home, and you could, by linking all of your electrical wiring through and to the PC, arrange to program lights on and

off, swimming pool pumps, air-conditioning, toasters and so on. The answer is: It's too hard. All I want to do is boil a kettle. I don't want to take a course in programming.

Is it technologically possible? Does it sound good? Yes, of course it sounds good. What are all these PCs doing in people's homes? In large measure, home entertainment. People now write a letter or do a spreadsheet. Is their life enriched? Has their economic circumstance changed? Of course it hasn't. So my sceptism is: Can you do it? Of course, you can do it. Will the public buy it? Will the dogs eat the dog food? I doubt it. Will some? You better believe it. We all of us have acquaintances and friends who will buy the last novel thing that came up.

The other thing is that I don't think it will evolve in the way that it's being put forward. Forget about the printer and the fax and the TV and the PC. A fax is just a printer with a scanning capability or an electronic-receive capability. So cross out the fax. The scanner with TV technology can be integrated into the front of the TV tube. If you want to scan something, stick it on the front of the TV tube, scan it into your attached PC, transmit it however you want, or print it out on a slave printer. Incidentally, if you're into financial transactions, then you'll just have some kind of credit card receiving capability which equals a modem. So I don't think it will get implemented the way the piccies are drawn. I don't think it will get implemented!

AC: Really?

Finn: No, I don't. I think it's technologically possible. But I think the public at the end of the day will by and large use the PC for home entertainment and I don't think they'll be bothered to use all these things.

AC: In relation to convergence, one reads almost daily about corporate mergers and alliances.

Finn: I think you have to have that, partly because of the risk and partly because these technologies are really quite difficult. If you look at a company like IBM, we've had attempts to get into the telecommunications business. We bought the Rolm Corporation and we've had alliances with US telecommunications companies such as MCI. And if



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you look at telecommunications companies, they've had attempts to get into the information technology business. The truth of the matter is I don't think anyone would declare victory in those excursions.

AC: *What about AT&T and NCR? Your parent company must be watching that merger fairly carefully?*

Finn: I don't believe that's true. I don't in any way mean to be derogatory, but NCR is not a significant player in information technology today.

AC: *Recognising that IBM spans the IT business from hardware to software and services, who is your major competitor?*

Finn: The thing we're most concerned about today are those who compete with us in the services as opposed to the hardware and software part of the business. This is because services, and the way they're being delivered, represent more than 50% of revenues of the industry in which we participate. So generically, services, and the competitive aspect, is the area I worry about most because of its size, because of the profitability you can derive, and because it's new for us. Because services are still high value-add, they have the potential for better profitability than you can get today from hardware, in particular, which is very much more a commodity driven by the cost of production.

If you look at IBM during any five year period, in any level of the hardware technologies we're in, I think you would find it impossible to name a competitor who has assumed a position of supremacy over IBM. At the end of the day, we understand technology, we have a strong record in it, we put a lot of research money into it and we ought to be able to be successful. While from time-to-time we see innovation from competitors that would be troublesome, I have got total belief in our ability to deal with that, to react to it and to continue to be successful. But there are many strong competitors in the services arena.

AC: *The industry alliances, often between competitors, are extraordinary. I've read that IBM worldwide has some 500 alliances.*

Finn: That's probably right.

AC: *What formal alliances or partnerships does IBM have here? For instance, you had a shareholding in Paxus?*

Finn: We had a 15% share in Paxus which we're in the process of divesting. There were some time constraints on when the shares should be sold as part of the sales agreement with the firm that bought Paxus.

AC: *Are there any other alliances or partnerships?*

Finn: About four years ago, we had about half a dozen, but very few of those have endured. For example, we own part of SSA

Australia who provide an application package and services for manufacturing and distribution companies. But we've exited most joint ventures where we had equity.

AC: *Is that a sign of hard times?*

Finn: No. It's more a sign that our expectations of what equity would bring, and perhaps in some cases our partner's expectations, weren't met. We were naive in retrospect. It's interesting that we have been able to achieve more success when we've sat down and decided a project is in the interest of both companies than we have through equity arrangements.

AC: *Is there an alliance between IBM's Information Systems Outsourcing Australia and BHP IT?*

Finn: We don't have any alliance in a conventional sense with BHP IT. We occasionally bid jointly where we're the prime contractor and occasionally the roles are reversed. We sometimes joint bid with CSA and we compete with them. We joint bid with BHP and we compete with them.

AC: *Does the IBM Information Network provide a competitive advantage in terms of your outsourcing business?*

Finn: IIN is a commercial entity that provides services internationally for a fee to the people who use it. We're looking currently at capitalising on that by bringing together all of the processing for Southeast Asia into one single location, and Australia might well be the location. That will be for all of IBM's internal computing and also for any computing that we outsource from our customers through the Asian region.

AC: *Does that mean labour costs here are now competitive with Singapore or Malaysia for instance?*

Finn: If you think about centralised computing, the cost of the equipment is pretty much the same wherever you do it; the cost of people is really of no account; but the cost of real estate is significant. Our real estate costs are among the cheapest of the countries that one would focus on like Hong Kong or Singapore. Therefore, Australia is the low cost producer subject to other things like taxation and the way in which revenue flows are treated, but these are manageable items.

Having said that, the further you get up the technology scale in terms of skills, the more Australia becomes the low-cost labour country.

AC: *What about the skill levels here in relation to Hong Kong or Singapore?*

Finn: In general, they're higher. It's fundamentally a supply and demand issue. Look at a country like Korea, with a rapidly growing economy, that is applying technology and has a shortage of skilled technologists. That is not the case in Australia.

AC: Does IBM Australia require approval from its parent to become an Asian hub?

Finn: It really needs an agreement by the Chief Executive of the Asia Pacific group.

AC: Is this located in Japan?

Finn: Yes, Tokyo.

AC: Wasn't there an announcement several years ago that IBM was using Australia as a telecoms hub?

Finn: We do have very significant telecommunications links around the world. We access about three satellite linkages out of Australia.

AC: So you would be one of Telstra's biggest customers?

Finn: Well, our total spending on telecommunications would be of the order of \$12 million a year, so we're not huge.

AC: But you're big in Australian terms?

Finn: Yes. And certainly per employee, if you want look at some statistics, we're extremely large. The banks would be bigger, but not per employee.

AC: And IBM's number of employees is reducing daily?

Finn: Yes. It's pretty well stabilised now. But what we're looking at is a different order of magnitude. Instead of having different computing centres that handle the processing for the IBM company in each Asian country, all of that traffic will be handled and processed in Australia. And as we move into the outsourcing business, as customers in those countries from time-to-time ask us to handle their computing workload, then we will bring that computing back to Australian centres. So that's very much the hub that we are now talking about. The hub we talked about in the past is really just a communications hub to satisfy IBM Australia as part of the worldwide network.

AC: Are you marketing the IIN actively here?

Finn: Not really.

AC: Why not?

Finn: In most cases, the only reason for using IIN is to get access to computers elsewhere. We don't need that access because we have substantial computing capability here today that we have chosen to have for internal business reasons. We have a basic level of overhead to pay on that.

AC: There are three IBM Directors on the Telstra Board. What added value does that offer to Telstra?

Finn: I don't think it intrinsically adds anything. You have to look at who they are. Alex Morokoff, who is Deputy Chairman, was Chairman of Telecom when it merged. He is a prominent, professional company director.

He is not an executive of any company, nor has he been, since he left the Thiess organisation. Alex has been on our Board since the early '80s and, I'm sure he was invited onto the Telecom Board because of his broad range of activities. I don't think there's anything other than coincidence that he was on the Telecom and IBM Boards.

AC: I assume this applies to Mike Codd too. What about yourself?

Finn: Mike Codd is on the IBM Board because we have a very high regard for his capability. We benefit from his knowledge of the public service and how it operates, given the public sector is 50% of the market for information technology products. The fact that he's on the Telstra Board is quite immaterial.

"... I believe most families probably do not use their videorecorder other than to press 'play' and 'rewind.' That's about the limit to which they want to get involved in that very simple technology. It doesn't matter what the technologists think. People aren't interested, they don't want to know. So this issue of convergence technologically is possible. The big unknown is the extent to which the public wants to buy in."

AC: Without going into more detail, does the IBM link add some value for Telstra? IBM has a range of experience and skills that could support Telstra's moves offshore, for instance.

Finn: Indeed.

AC: Has that happened?

Finn: Not other than at a very superficial kind of level. For example, rarely have people from Telstra, when they've gone to a particular country, met up with IBM. That's not so much because of my Board membership but simply because IBM is prominent in those countries. We are customers of Telstra and Telstra is a customer of ours. It's just a kind of networking. I was asked to go on the Telstra Board by the Government. I have done a lot of work for government over a long period of time, particularly in education, I have a background in technology, I have lived and worked in India, Hong Kong, and the United States, I'm a 'Pom' by birth and I have some business experience in personnel management.

AC: In no way was I questioning anyone's qualifications. I was thinking an 'alliance' could be quite valuable for both companies.

Let me take the example of ATM technology which I understand is a strategic direction for IBM.

Finn: That's right.

AC: Telstra is launching an experimental broadband network using ATM technology and I understand IBM is seeking a strategic alliance in this area.

Finn: I know that Telstra people involved in that activity keep in very close touch with our Networking Systems people based in the UK, run by Ellen Hancock. Without reference to anyone in IBM Australia, and without reference to me as a Board member, those linkages occur.

AC: What about IBM Australia? Will it have a role in IBM's overall strategy to move into ATM technology?

Finn: In the sense that you ask the question, I think, no.

AC: What about an area such as Telstra's cable TV tender. Is IBM interested in that opportunity?

Finn: I'm not aware of any involvement, but that would be a local involvement by IBM Australia. It would be distinctly operational.

AC: As opposed to...

Finn: As opposed to research activity which Hancock handles in telecommunications.

AC: It clearly requires an understanding of how IBM Australia works in with rest of the company?

Finn: The two examples are worth pondering. Cable TV would be an operational project and we would handle it. If we needed help from Hancock's group, we would go to them and that would be transparent to the customer. On the other hand, joining IBM, the information technology company, and Telstra, the telecommunications technology company, means the people with that research capability act together without an intermediary. That's a very direct linkage because it's dealing with future products of some substance.

AC: Based on what you've said, do you have any conflicts of interest sitting on the Telstra board?

Finn: None whatsoever. The only time I've had occasion to raise it was when Telstra was in discussions with IBM about taking space in this building which we own. The Telstra Board is a very experienced group of people from a very wide cross section of backgrounds, and the whole Board is very mindful of conflicts of interest, both on their own part and on the part of colleagues. So it's not an issue.

AC: Where do you see IBM's role in relation to telecoms in this country. Can you see opportunities?

Finn: I think we have the strongest role to play in the technologies that support and surround the new directions emerging in telecommunications.

AC: Are you referring to technologies such as ATM?

Finn: Yes. ATM, broadband but, equally, the technologies that support implementation. For example, Systems Network Architecture. I've never thought of that as being 'in the field of telecommunications' i.e. Telecom, Optus and so on, but it is very important for the general development of computing and the application of information technology. I see that kind of thing being replicated as we move into these new telecommunications fields.

AC: Optus has promoted the development of a new Operational Support System [OSS] with Digital as prime contractor and I understand IBM has worked on facilities management for wireline billing...

Finn: We actually provide the outsourcing requirements for Optus on our mainframe.

AC: Could IBM be interested in helping Telstra lift its game in relation to OSS?

Finn: Oh, we'd love to. We'd love to. Absolutely. Telecom is a huge organisation and we'd very much like to be involved there as we are with Optus.

AC: Have you tried?

Finn: Well, yes. We provide the Directory Assistance systems and have done for many years. Telecom has consistently been on a path of using IBM-compatible large systems hardware, and in the past four years have moved to have more of an IBM involvement. We sold substantial IBM equipment into Telecom three years ago and again this year. So, yes, we have asked.

AC: But that's different from designing and supplying an overall OSS?

Finn: I think strategically there's an opportunity. It's back to my comment about how difficult it was for IBM to get into telecommunications and how difficult it is for telecommunications companies to get into information technology. The actual operation of a telephone network is becoming more software dependent than hardware dependent and we as a company have very good software skills on a broad range of fronts, not the least of which are network architectures and implementations.

AC: Looking back, you arrived at IBM Australia about the same time that Business Telecommunications Services [BTS], the pro-competition telecoms lobby group, was formed...

Finn: No. I arrived in December 1980 and I think BTS had been formed for at least a year. I didn't agree with BTS.

AC: Yet IBM was seen as the major force in BTS which was headed by Peter Holmes a'Court from IBM. Why didn't you agree?

Finn: For just that sort of reason. It was an association that was misconstrued. IBM was in favour of less regulation and more deregulation of the telecommunications market and that was what BTS was about. It had many other prominent organisations in it. You had to have somebody to head an organisation like that, and the skills to do so are not prolific in Australia. So it was not unnatural that the partners should say to IBM: 'We need somebody to head this up, have you got somebody?' And we said: 'Yes, we suppose so.' What that translates to in the market is: IBM is trying to take over the world of telecommunications.

AC: It was certainly seen that way. IBM had adopted satellite as a strategy at that stage through Satellite Business Systems in the United States.

Finn: That's why I don't agree with it, you see.

AC: IBM is often credited with exporting or pioneering telecoms competition around the world, and BTS was seen as the beginning here. I'm sure you wouldn't disagree with that?

Finn: No. I wouldn't. But I think it was a level of pioneering and, in a business sense, public spiritedness, that was detrimental to us. We should not have led the charge. We should have left it to others.

AC: Was BTS ten years too early?

Finn: No. I think IBM, because of our origins and ownership, were ascribed incorrect and unfortunate motives because of our prominence in BTS. I think people thought we were out to take over the world of telecommunications in Australia. We were not. In retrospect, I think BTS did fine things. It was quite an appropriate organisation. I was not in favour of IBM's prominent role in it.

AC: Turning to your manufacturing facility at Wangaratta, is that important for the Partnership for Development [PDP] agreement with Government?

Finn: The agreement has lapsed. It was completed in 1992. But, yes, it was pivotal, because it accounted for almost 50% of exports we generated.

AC: What do you think of the PDP scheme?

Finn: From the standpoint of Australia, I think it has generated a level of exports it would not have generated otherwise. In IBM's case, it generated a level that would not have occurred as quickly, but they would have occurred. From IBM's point of view, in the nicest possible way, you have to say that it is a coercive tool because it brings no discernible benefit other than allowing you to participate in the market. If you don't

participate, you can't get government business. If you do participate, you are eligible for government business.

AC: In theory, couldn't the PDP give you leverage with your parent to do some crucial R&D here?

Finn: Yes. But it is not a positive policy from the standpoint of the partner.

AC: Do you mean that it's punitive?

Finn: Absolutely. It says: 'Unless you do this, you won't be allowed to participate in the market.' It offers no positive advantage.

AC: Didn't your PDP involve the targeting of R&D as well as exports?

Finn: Yes. We complied every year in meeting both targets. The question is: 'What has happened to those who not did not comply?' Answer: 'Nothing.'

AC: It's difficult to know what the PDPs involve because they're not public.

Finn: I know!

AC: Do you know about the PDPs of your competitors?

Finn: I know about some of them!

AC: Was a corporate decision taken in the US to close down Wangaratta as part of the overall rationalisation?

Finn: Early last year, the corporation looked at all its manufacturing facilities because we had too much capacity. In that context, Wangaratta, which makes PCs and RISC systems, quite rightly got put on the table. If you look at the PC portion, we have four PC plants around the world. Wangaratta is in itself extremely efficient, but it is not a question of whether it is efficient. The question is: Do we need four PC plants? If the answer is no: Which one do we want to close? It never got to that point.

AC: Could it get to that point?

Finn: Yes. And why shouldn't it? It's a perfectly legitimate, reasonable question.

AC: What has IBM as corporate citizen delivered to Australia? Jobs? Skills?

Finn: Yes. Jobs, skills, and more taxes than the rest of the industry put together! We're the largest exporter of elaborately transformed manufactures, with no Government assistance. We export more than Ford and General Motors. We have no tariff protection. We have no discernible benefits, nor do we ask for any. We have no infringements of the law...

AC: Is it correct that your exports are about \$500 million?

Finn: A bit less. About \$400 million.

Liz Fell is a freelance journalist based in Paddington (NSW).

The Paperless Office — More Trees, Less Evidence

The admissibility of electronically created or stored documents in court remains a risky proposition. Reay McGuinness considers the problems and suggests some steps to minimise the risk.

There is an ongoing debate in legal circles about how the legal system can reconcile established rules of evidence with the maze of evidence problems thrown up by information technology. There is a larger debate in the community concerning the costs of justice. Any litigant paying to watch lawyers arguing over admissibility of optically stored and electronically created documents which are a normal part of commercial life would recognise the connection between the two.

An optically stored document is a document which has been optically copied (or scanned) and the original document destroyed. An example of an electronically created document is where the details of a discussion (such as a purchase order) are recorded directly onto an 'electronic document,' with no paper document created at the time.

What's the Problem?

There are two rules of evidence which create difficulties in having optically stored and electronically created documents admitted into evidence.

The first is the best evidence rule, which is that the best evidence that the nature of the case will allow will be admissible. Where an original document has been destroyed, a copy of that document will not automatically be admissible.

The second is the hearsay rule, which is that oral or written evidence of a person which seeks to establish the truth of something said or written by another person is inadmissible. The evidence of X repeating a conversation with Y where Y relayed the contents of a conversation with Z is not admissible as to the truth of what Z said. However X's evidence is admissible as to the fact that the conversation with Y occurred. The exceptions to the hearsay rule are complex. Attempts to clarify those exceptions as they apply to optically stored and electronically created documents are dealt with below.

Admissibility

The purpose of these rules is to provide legal protection to a person against whom evidence in breach of the rules is sought to be led. Whilst computer professionals are often prepared to rely on optically stored and electronically created documents without further examination, the Courts have taken a more conservative view. This conservatism is based on the ease with which documents stored in

a computer can be manipulated to produce inaccuracies. When those inaccuracies become part of evidence in litigation, the consequences can be serious. Most Australian businesses with information technology that incorporate electronically created and

optically stored document systems will trade in more than one State — making the varying legal positions from State to State even more hazardous.

There are four possible routes to take in overcoming the admissibility problems:

- The general law which allows copies of documents to be admitted in a range of situations;
- Machine copy legislation;
- Business records legislation;
- Computer-produced documents legislation.

The following summary of these routes does not purport to deal with the intricacies of the evidence laws of each State, but merely demonstrates the problems which exist.

Firstly, in all States, it is possible to have an optically stored document admissible where the original has been

destroyed. Evidence would need to be given of the accuracy of the copying technique, the inalterability of the storage system and the circumstances in which the original was destroyed. This does not apply to electronically created documents.

Secondly, in NSW, Victoria, ACT, Queensland, Tasmania and South Australia, there is 'machine copy' legislation. This legislation came into existence many years before the advent of sophisticated information technology. It requires the same sort of evidence discussed above to be given to make optically stored documents admissible. The legislation cannot be relied upon to make electronically created documents admissible.

Thirdly, all States have business records legislation, but the requirements for compliance with the business records legislation of each State vary.

The first requirement of the business records legislation is that the statement of fact sought to be admitted must be in a document which forms part of a record of a business and have been made in the course of or for the purposes of the business. The second requirement is that the statement must have been made by a person with a personal knowledge of the facts being stated, or who has certain expertise, as well as having some relationship to the busi-



ness; or the evidence must be information reproduced from a recording device.

These deceptively simple-sounding requirements are a lawyers' picnic for argument, and often misunderstood. The following example demonstrates why the business records legislation is unsatisfactory for the purposes of making optically stored documents admissible.

Leonard Pty Ltd sends a purchase order to Waters Pty Ltd, for 50 shirts at \$50.00 each, to be delivered within 30 days. The shirts are delivered. The purchase order is scanned onto Waters' computer system by O'Brien and destroyed. Leonard doesn't pay, and Waters sues. Leonard denies having ordered the shirts. Waters must prove that Leonard ordered the shirts. Any invoice, whilst supporting this inference, is not conclusive proof of the order having been made. There is no problem with satisfying the first requirement of the business records provisions.

The second requirement is more problematic. O'Brien has no personal knowledge of the matters contained in the purchase order. The optically stored purchase order is information supplied by a person (e.g. Leonard) not associated with the business of Waters and is therefore not information reproduced from a recording device for the purposes of the business records legislation. The optically stored purchase order may not be admissible as evidence of the fact that a purchase was made, although it would support that inference.

Finally, Victoria, South Australia, the ACT and Queensland all have specific computer-produced records legislation. This legislation is fragmented. The South Australian approach of satisfying the court that all of the usual avenues through which computer input might be affected is the most satisfactory. This includes such matters as regular programming of the computer, malfunctioning etc. Those matters are further discussed below.

Risk Management

The above demonstrates that there is not any risk-free way to combine the paperless office with the current evidence laws. The precautions which a business is prepared to take to ensure the admissibility of optically stored and electronically created documents is going to be influenced by considerations such as whether the cost of taking the precautions is worthwhile, and the likelihood of the documents in question ever being needed for litigation.

The critical factor in ensuring optically stored and electronically created documents will be admitted into evidence is to ensure that the documents are safeguarded against potential variation in the copying and storage process. If there is potential for the document to be electronically altered, there will be legal doubt about either the admissibility of the document, or the weight to be given to the document. The following guidelines will be of assistance in minimising the risk of having optically stored and electronically copied documents admitted into evidence.

Firstly, documents to be optically stored should not be copied from paper into computer memory or onto computer tapes or another 'dynamic medium' before being downloaded onto a 'fixed storage medium' such as microfiche or optical disk. The paper version should be copied straight onto the microfiche or optical disk. (Another version may be created at the same time on the computer system for use by staff as a 'working copy'.)

Secondly, documents to be optically stored should not be 'cleaned up' electronically before being copied on to the fixed storage medium. If there are problems with a copy of the paper version, the paper version should be recopied rather than the electronic version amended (though the 'working copy' can be amended for day-to-day use).

Thirdly, ensure that the documents held on the fixed storage medium are not capable of amendment or variation. The 'working copy' can be changed for operational purposes, but only the document on the fixed storage medium can be used in any court proceedings.

Fourthly, the business should be able to provide evidence from a person closely familiar with the optical storage process (preferably with computer qualifications), which addresses the following:

- That the computer which produced the document is correctly programmed and regularly used to produce documents of the same kind as the documents sought to be tendered;
- That data from the relevant computer is systematically based on information that would be evidence of the statements or representations which the document sought to be tendered is seeking to prove;
- That there is no reasonable cause to suspect any departure from the system procedures or any error in the preparation of the documents sought to be tendered;
- That the computer has not been subject to a malfunction which might reasonably be expected to affect the accuracy of the documents sought to be rendered;
- That there were no alterations to the mechanism or processes of the computer that might reasonably be expected to affect the accuracy of the documents sought to be tendered;
- That records had been kept by a person in charge of the computer of alterations to the mechanism and processes of the computer during the period. It may be necessary to put on evidence those records;
- That there is no reasonable cause to believe that the accuracy or validity of the output has been adversely affected by the use of any improper process or procedure or by inadequate safeguards in the use of the computer;
- That at no stage in the copying process could the electronically verified copy or archived copy be altered.
- The affidavit should provide for a sample copy run to be done of the particular type of optically stored document which is sought to be admitted. This will provide the court with a tangible example of how an original document passes unchanged through the optical copying system.

Finally, it may be possible to try and avoid admissibility problems by obtaining an acknowledgment from the other party to the document that the party would not object to the document being admitted in an optically stored or electronically created form. There is a legal concept known as 'waiver,' which allows parties to expressly give up certain rights. The practical disadvantage of seeking such a release from another party is that it may give the impression of a threat of litigation. The legal problem with this approach is that there is no guarantee a court would recognise the acknowledgment.

Change on the Horizon

It is anticipated that the Commonwealth and New South Wales will shortly introduce new Evidence Bills which will reform the laws relating to optically stored and electronically created documents.

Much has already been written about the proposed reforms. Disciples of the paperless office will be frustrated by any new laws which continue to place oppressive requirements of proof on those seeking to have such documents admissible, while those who see the traditional rules of evidence as fundamental protections will be concerned about any attempt to lessen those requirements. Ultimately, the reformers must look to the outside world, where optical storage and electronically created documents have become a routine part of commercial life. There is a legal concept known as judicial notice which allows a Court to declare that it will find that a fact exists. For example, there is no need for a person to adduce evidence in support of the fact that the sun rises every morning. The time may have arrived where the reliability of technology relating to optically stored and electronically created documents means that judicial notice can be used more flexibly in presuming the accuracy of the information technology systems.

Reaymond McGuinness is a litigation lawyer with the technology law firm Gilbert & Tobin. This column sets out his views and not those of clients of his firm.

Choosing Between High-Speed LAN Technologies

Prospective users of high-speed LANs face a bewildering array of choices: four flavours of FDDI, three kinds of Ethernet, Fibre Channel, high-speed Token Ring, and even ATM.

There's no final exam for network managers — at least not officially. Keeping a network up and running is a tough enough test, and the people who do it for a living learn early on that difficult decisions far outnumber easy answers.

But even honours graduates of the internetworking school of hard knocks can draw a blank when it comes to choosing high-speed LAN technologies. It's not just a matter of doing homework: Plenty of straight-A students end up with a bad case of test anxiety when faced with what's starting to look like the mother of all multiple-choice questions:

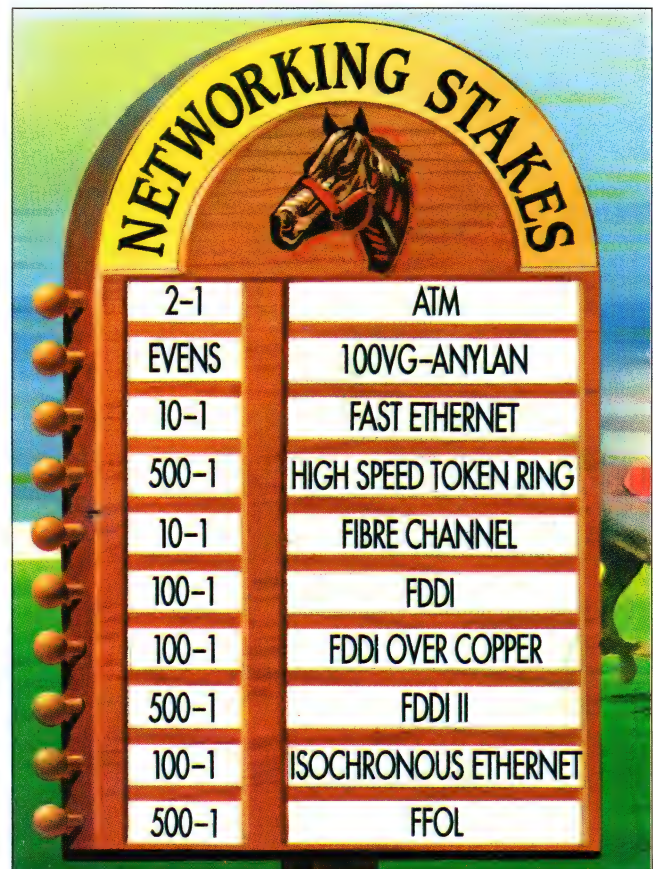
Your network is fast running out of bandwidth. Some users are starting to complain about response time. Others are asking about multimedia. ATM as a viable technology is still years away. You've got to act now. Which of the following high-speed LAN technologies can solve your current performance problems and keep a path open to asynchronous transfer mode?

- ☐ FDDI
- ☐ FDDI over copper
- ☐ FDDI II
- ☐ FFOL (FDDI Follow on LAN)
- ☐ Fibre Channel
- ☐ High-speed Token Ring
- ☐ Isochronous Ethernet
- ☐ Fast Ethernet (100VG-AnyLAN)
- ☐ Fast Ethernet (100Mbps CSMA/CD)
- ☐ ATM (deploy as products arrive)
- ☐ None of the above
- ☐ All of the above

Time's up. Pencils down. Okay, it's a trick question: there really isn't one correct answer. Internetworks through the rest of the decade are going to be a patchwork of LAN technologies. A manufacturer of household appliances, for instance, might go with 10Mbps Ethernet to link PCs in its sales department, run 100Mbps 100VG-AnyLAN to connect graphics applications, and build a 530Mbps Fibre Channel LAN to tie together the Sun workstations in its R&D lab.

But knowing which technologies to pick remains a problem: some LAN standards are suited to multimedia traffic; others only come into their own when pushing asynchronous data packets. Some can serve in the backbone; others are intended for desktop connections. Some can run over the cables now in place in walls and risers; others are only going to get the green light once fibre's been pulled.

And that's just to start with. Even something that seems as straightforward as line speed is complicated by architectural con-



siderations. Network overhead also must be evaluated carefully, along with the sorts of delays that can be expected with different LAN technologies (and how they'll affect time-sensitive interactive applications). Compatibility with existing networking gear also deserves close attention, and cost — the net manager's perennial worry — needs to be factored into any decision.

If all this sounds as if 'none of the above' is the smart answer, best sign up for some remedial classes ASAP. Sure it's possible to

Table 1: Setting the High-Speed Standard

	STANDARDS GROUP	TRAFFIC	APPLICATION	STATUS	ARCHITECTURE	DATA RATES
STANDARD						
ATM	ATM Forum, IETF, ITU-TS	Data, voice, multimedia	Desktop, LAN backbone, MAN, WAN	Basic elements in place, more features due over next 18 months	Switched	25Mbps, 52Mbps, 155Mbps, 622Mbps (2.488Gbps planned)
FDDI	ANSI	Data, some multimedia	Desktop, LAN backbone	Ratified	Shared media	100Mbps
FDDI over Copper	ANSI	Data, some multimedia	Desktop	Stable draft, awaiting final ratification	Shared media	100Mbps
FDDI II	ANSI	Data, multimedia	Desktop, LAN backbone	Stable draft expected 1Q 1994	Shared media (some traffic carried in circuits)	100Mbps
FFOL	ANSI	Data, voice, multimedia	Desktop, LAN backbone, MAN	No date set for draft or ratification	Shared media (some traffic carried in circuits)	150Mbps-2.4Gbps
Fibre Channel	ANSI	Data	Desktop, LAN backbone	Stable draft, due for final ratification	Switched	133Mbps, 266Mbps, 530Mbps, 1Gbps
High Speed Token Ring	IEEE	Data, multimedia	Desktop, LAN backbone	No date set for draft or ratification	Undecided	Undecided
Isochronous Ethernet	IEEE	Data, multimedia	Desktop, LAN backbone	Stable draft expected by 4Q 1994	Shared media (some traffic carried in circuits)	16Mbps
Fast Ethernet (100VG-AnyLAN)	IEEE	Data, some multimedia	Desktop	Stable draft expected by 1Q 1994	Shared media	100Mbps
Fast Ethernet (CSMA/CD)	IEEE	Data, some multimedia	Desktop	Stable draft expected 1Q or 2Q 1994	Shared media	100Mbps
TECHNOLOGY						
Full-duplex Ethernet³	N/A	Data, multimedia	Desktop	N/A	Shared media	20Mbps
Switched Ethernet	N/A	Data, multimedia	Desktop	N/A	Switched	10Mbps
Switched FDDI	N/A	Data, multimedia	Desktop, LAN backbone	N/A	Switched	100Mbps
Switched Token Ring	N/A	Data, multimedia	Desktop	N/A	Switched	16Mbps

1. Latency for switched technologies assumes traffic passes through one network switch
2. Theoretical limit; most networks use 4,000-byte packets
3. Works only in conjunction with Ethernet switches

keep on segmenting Ethernets and Token Rings with bridges and routers, though why anyone would want to pursue this approach is one of life's great mysteries. It's a headache to manage, can become fantastically expensive, and introduces irksome levels of delay every time traffic is sent between segments.

A better tack would be to add a proprietary LAN switch — a device that essentially acts like a very fast multiport bridge — to overburdened networks. This makes it possible to dedicate fixed amounts of band-

width to each node, boosting performance without having to trash installed adaptors or cabling (see 'Power Switches Pump Up Performance' on page 62). But LAN switches have their own drawbacks. In some circumstances, for instance, they can cause network congestion.

One more thing: opting for 'all of the above' is asking for trouble. The market can only support a limited number of LAN technologies. Some of the high-speed standards being talked up so enthusiastically at IEEE and ANSI meetings are going to end up in

the 'Where are they now?' file. Technology also-rans don't make for successful long-term implementations, and net managers need a way to identify potential dropouts early on.

School Daze

The place to start this crash course in LAN technologies is with the standards now on the books or scheduled for ratification in the next few years (see Table 1). Of this group, five implement a token-passing architecture: FDDI (fibre distributed data interface)

COPPER CABLING

NETWORK OVERHEAD

TYPICAL LATENCY (FIXED OR VARIABLE)¹

Categories 3 and 5 UTP; STP

9.5 percent

20-30 microseconds (variable)

None

0.5 percent

10-200 milliseconds, 8-16 milliseconds with synchronous facilities enabled (variable)

Category 5 UTP; STP

0.5 percent

10-200 milliseconds, 8-16 milliseconds with synchronous facilities enabled (variable)

None

0.5 percent

125 microseconds (fixed)

None

Undecided

2-5 milliseconds

Thin and thick coax; STP

1.7 percent

10 microseconds

Undecided

Undecided

Unknown

Categories 3, 4, and 5 UTP; STP

1.6 percent

Less than 100 milliseconds (fixed)

Categories 3, 4, and 5 UTP; STP

1.6 percent

121 microseconds minimum (variable)

Categories 3, 4, and 5 UTP; STP

1.6 percent

30 milliseconds maximum (variable)

Categories 3, 4, and 5 UTP

1.6 percent

Unknown

Categories 3, 4, and 5 UTP

1.6 percent

38 microseconds (variable)

None

0.5 percent

10 microseconds (variable)

Categories 4 and 5 UTP; STP

0.1 percent²

Unknown

ATM = Asynchronous Transfer Mode

FFOL = FDDI Follow-on LAN

ITU-TS = International Telecommunications Union - Telecommunications Standards (formerly CCITT)

transmits data at 100Mbps and is the only high-speed LAN that's been ratified to date. FDDI over copper (sometimes referred to as CDDI) also runs at 100Mbps but works with copper cabling. FDDI II is a new version of the fibre interface that's geared to multimedia; it also operates at 100Mbps. FFOL (FDDI Follow-on LAN) is eventually meant to take the place of FDDI and may ultimately operate at 2.4Gbps. High-speed Token Ring has only just been submitted to the IEEE.

Three more standards are intended as successors to Ethernet. Both of the new

so-called fast Ethernets — 100VG-AnyLAN and 100Mbps CSMA/CD (carrier sense multiple access with collision detection) — operate at 100Mbps over copper. Isochronous Ethernet is a 16Mbps spec meant for multimedia.

Finally, two of the evolving high-speed standards now being developed are based on switching architectures. ATM supports a range of speeds — all the way up to and including 622Mbps, with faster rates in the works. Fibre Channel also operates at a number of rates — up to 1Gbps.

Increase and Multiply

One of the reasons that network managers now have 10 high-speed LAN technologies to sort through is that the IEEE (Institute of Electrical and Electronic Engineers) seems to be working overtime to define them. Half of the aforementioned specs come courtesy of the IEEE, a curious turn of events given that ANSI (American National Standards Institute) was originally supposed to take care of all standards operating above 20Mbps.

The IEEE's newfound responsibilities illustrate the fact that standards have become big business — particularly for companies that can get their proprietary technologies standardised. The financial factor has spurred vendors to push hard to get their technologies stamped with an IEEE seal of approval — a procedure that has proved ludicrously easy since standards committees are made up almost exclusively of vendor representatives. This can spell trouble for network managers, who lack an official ombudsman to voice their opinions and concerns.

Fast Ethernet is a good example of the standards approval process gone awry. The IEEE's original request for proposals yielded two candidates. 100VG-AnyLAN is the brainchild of AT&T and Hewlett-Packard; 100Mbps CSMA/CD is the work of a broad group, which includes 3Com, Ungermann-Bass and SynOptics Communications.

The IEEE was supposed to give the nod to one fast Ethernet proposal. Last July, however, it announced that it couldn't choose and would ratify both. 100VG-AnyLAN will become IEEE 802.12; 100Mbps CSMA/CD will either become an addendum to IEEE 802.3 or will become a standard in its own right. Granted, each take on fast Ethernet has something to offer, but the IEEE compromise has struck some in the industry as duplicitous.

Life on the Fast Line

If life were simple, assessing high-speed LAN technologies would merely be a matter of comparing data rates. Unfortunately, there's a lot of confusion as to what throughput figures really indicate about performance. On shared media LANs such as FDDI or fast Ethernet, line speed decreases in proportion to the number of nodes contending for a portion of the total available bandwidth (100Mbps in both cases). Thus, line speed (the throughput to any single node) is only going to equal total throughput when there is just one node being serviced. On a 10-node FDDI installation, for example, each node on average gets no more than one-tenth the available bandwidth.

On switched LANs such as ATM and Fibre Channel every node is attached to a dedicated segment. Thus, line speed is no longer proportional to the number of nodes. On a 155Mbps ATM installation, each link

Power Switches Pump Up Performance

The high-speed LAN standards now in development are not the only way to boost bandwidth and clear a path to ATM. Network managers can also enhance performance with a proprietary LAN switch. These switches are installed in place of conventional LAN hubs in the wiring closet, with networking gear connected in a star topology. Essentially, they act like very fast multipoint bridges, establishing dedicated segments to individual nodes (much the same as ATM and Fibre Channel).

By enhancing existing networks, proprietary LAN switches protect investments in equipment, furnishing the most cost-effective path to increased performance. Since each dedicated connection operates over an already deployed LAN link (Ethernet, FDDI, or Token Ring), net managers can continue to use the cable in their wiring ducts and the adaptors in their PCs, servers, and workstations. The greatest savings, in fact, accrue from eliminating labour charges.

Vendors have been quick to catch on to the power of the switching paradigm. Pioneers in this area — such as Alantec and Kalpana — have now been joined by a number of mainstream equipment suppliers. All told, at least 15 vendors now offer Ethernet switches, including Lannet Data Communications and Ungermann-Bass. Digital Equipment Corporation and Cabletron Systems have also announced products.

DEC is the only vendor now shipping an FDDI switch. Cabletron, Fibronics International, Standard Microsystems Corporation, and ACE/North Hills Electronics say they'll have FDDI switching gear sometime in the near future.

Eight networking vendors also have plans to launch Token Ring switches, in-

cluding 3Com, SynOptics Communications, and Ungermann-Bass.

Networks that have been reconfigured with LAN switches will never run as fast as ATM or Fibre Channel LANs; they can't since they start out with lower line speeds. But often they can easily deliver higher aggregate throughput than counterparts based on shared media architectures. A 40-node Ethernet LAN connected via a proprietary Ethernet switch has a total throughput of 400Mbps — four times that of 100VG-AnyLAN, one of the 100Mbps fast Ethernet standards.

Some Ethernet switch vendors have hit upon a way to further boost bandwidth — something called 'full-duplex Ethernet.' This new technology allows data to be passed in two directions simultaneously on switch-to-PC connections, effectively doubling network throughput to 20Mbps on each link. On conventional Ethernets, data cannot be transmitted in both directions at the same time because the collision detection part of the CSMA/CD protocol forces one end of the connection to stop transmitting. Cabletron has announced the formation of a consortium of eight vendors to develop and deliver interoperable products which will incorporate a full duplex switched Ethernet (FDSE) access method. The consortium includes Compaq, IBM, Kalpana, National Semiconductor, NCR, SEEQ and Texas Instruments. Last July IBM started shipping a full-duplex Ethernet adaptor that Kalpana says will work with a full-duplex version of its Ethernet switch. Cabletron also says that it will support full-duplex Ethernet when it adds an Ethernet switching module to its hubs this year.

Switch vendors claim that by eliminating network contention their products are

suitable for interactive multimedia applications. According to tests conducted at Harvard University, Ethernet switches can keep latency to an average 38 microseconds. DEC indicates that node-to-node delay with its Gigaswitch FDDI switch is around 10 microseconds, though no one has ever tested the product independently.

One of the reasons that switching is proving so popular with vendors is that it can be teamed with network management software to emulate one of ATM's most significant features — the ability to set up and tear down virtual workgroups without altering the physical network. By enabling net managers to set up virtual workgroups using point-and-click mouse commands from a network management console, LAN switches can save on the cost of moves, adds, and changes.

Not all switch vendors support virtual LAN capabilities, however, and those that do only offer it on a per-switch basis. Connections between LAN switches are still made using shared media (such as Ethernet or FDDI); virtual workgroups require logical circuits that can deliver full LAN speed — in other words, ATM. Virtually all Ethernet switch vendors plan on implementing ATM as a backbone technology between their switching gear.

On the downside, switches can cause several headaches. For one thing, the technology is not scalable. And in some cases switches may actually degrade network performance. Adding a switch to an Ethernet that's used for client-server applications can cause bottlenecks when multiple clients jam the switch connections to the server. Likewise, if the switch's internal throughput is less than the sum of its connections, traffic will pile up.

Stephen Saunders

runs at full line speed, as does every link that is added.

Most of the high-speed LAN standards now in the works — FDDI, FDDI over copper, FDDI II, 100VG-AnyLAN, 100-Base-X, FFOI, and high speed Token Ring — retain the shared media architecture of the original Ethernet and Token Ring. Performance increases come thanks to new signalling and encoding schemes, which boost total available bandwidth. But then bandwidth still must be divided among every node on the network. A net manager who replaces a 10Mbps Ethernet supporting 40 PCs with a 100Mbps FDDI network boosts the average bandwidth available to each user tenfold, from 250Kbps to 2.5Mbps — not to 100Mbps.

A far larger increase in throughput can be realised by going with either of the

switched architectures, ATM or Fibre Channel. If an ATM switch were added to the aforementioned 40-node Ethernet, the bandwidth to each user would jump to 155Mbps — 620 times that available with 10Mbps Ethernet and 62 times that furnished by 100Mbps FDDI.

How much bandwidth is available is only part of the story. How efficiently a network uses that bandwidth also is an important consideration. Network overhead — the amount of information shipped relative to frame size — is a good indicator of efficiency; the lower the overhead, the more effective the transport.

Playing the Percentages

ATM, for all its reputation as a top performer, actually uses its bandwidth less efficiently than any of its high-speed rivals.

Each ATM cell is 53 bytes long: 5 bytes are used for the header, the remaining 48 for the payload. ATM cells, unlike conventional LAN frames, do not have a trailer loaded with error-checking information.

To determine network overhead as a percentage of total bandwidth, divide 100 by the total frame size and then multiply by the size of the header. For ATM, that's 100 divided by 53 multiplied by 5, for a network overhead of roughly 9.5%. In contrast, the network overhead for FDDI, FDDI over copper, and FDDI II — all of which have a payload of 4,478 bytes and dedicated 23 bytes to headers and trailers — is 0.5%. Fibre Channel, which has a 2,112 byte payload and a 36 byte header, has a network overhead of 1.7%.

Bear in mind that isochronous Ethernet and 100Mbps CSMA/CD are affected by

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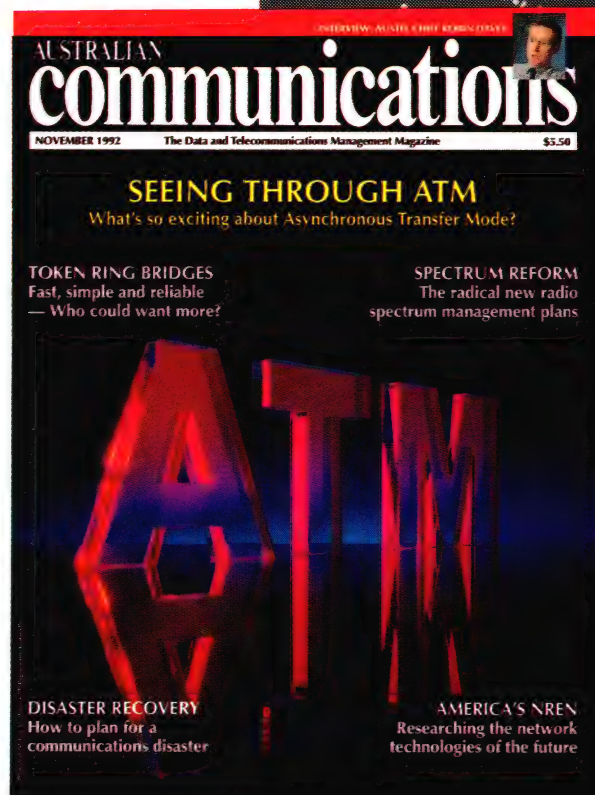


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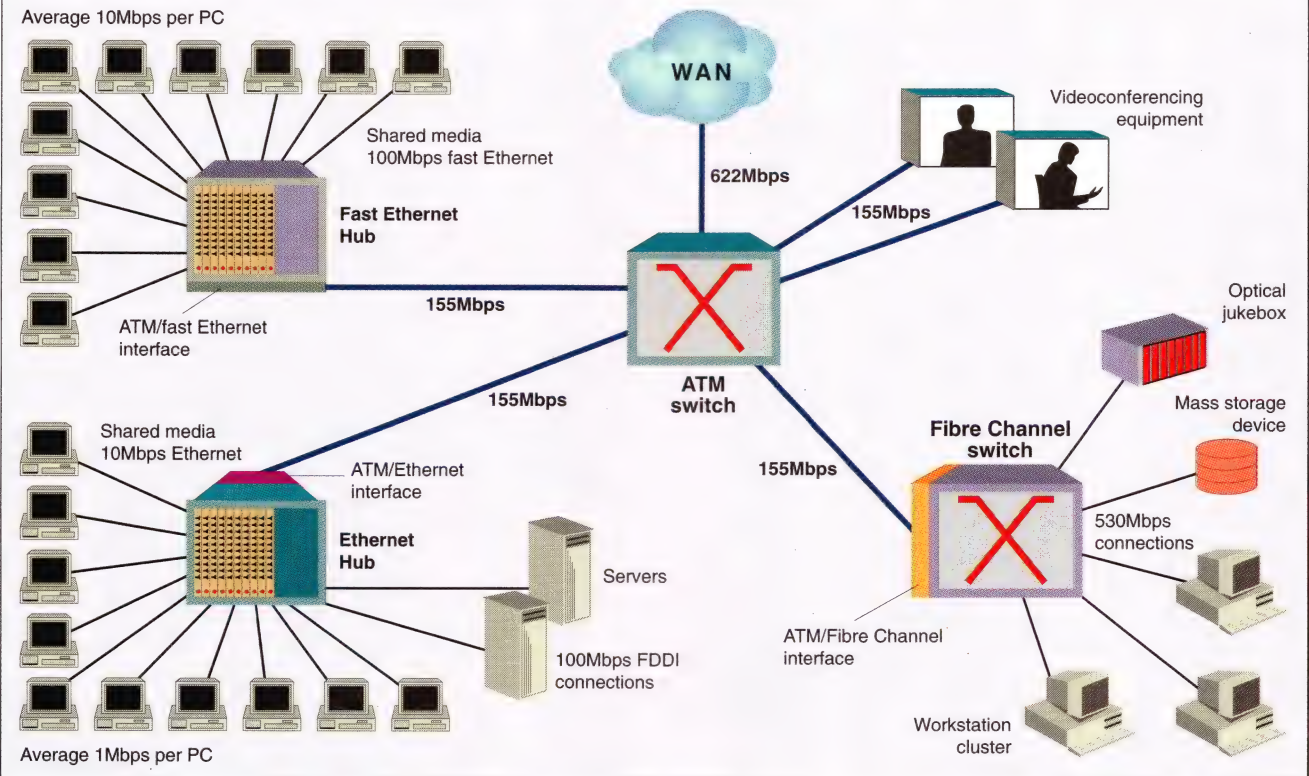
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Putting It All Together

Through the rest of the decade network managers will mix and match high-speed LAN technologies on their internetworks, putting ATM, fast Ethernet, Fibre Channel, and FDDI to work alongside conventional LAN schemes like Ethernet.



another kind of network overhead. Both rely on the carrier-sense multiple access with collision detection used on 10Mbps Ethernet to resolve contention problems. Tests by US-based LANquest Labs show that collision detection reduces available bandwidth on a 10Mbps Ethernet (with four servers and 12 PCs) to 6.8Mbps (by 32%). It's not yet clear how high overhead will be on 100Mbps CSMA/CD LANs.

High-speed LANs that employ a token-passing scheme to assign access are far more efficient. In tests conducted by US-based Interlab, FDDI delivered 96Mbps, or 96% of available bandwidth.

High bandwidth and low overhead are the two most important characteristics to consider when choosing a LAN that will carry asynchronous data, which is largely insensitive to delay (latency). But multimedia applications — particularly interactive voice and video — are best served by an isochronous technology, which delivers very low, predictable node-to-node latencies. As a rule of thumb, the higher and more varied the delay, the lower the quality of the interactive application. (It's important to realise that not all multimedia traffic is interactive: stored video and still images, for example, are not displayed until the receiving station has gotten the entire file; thus they can be transmitted asynchronously — without latency affecting quality).

What's more, if latency is to be used as an effective benchmark for multimedia, it must be measured from the moment a node first attempts to access a LAN to the moment delivery is complete; simply clocking the amount of time traffic spends in transit is not enough.

Hurry Up and Wait

Conventional shared media LANs such as Ethernet, FDDI, and Token Ring are inherently unsuitable for carrying interactive applications because they implement mechanisms to ensure that only one station can access the network at any time, forcing other nodes to queue up until it's their turn to transmit. If one node hogs the network by sending a lengthy file, the delay can crash the multimedia application. (With 10Mbps Ethernet, for example, latency sometimes can be measured in minutes). The easiest way to guarantee that interactive traffic is handled without delay on a shared media LAN is either to eliminate asynchronous devices or to segment the network further. Both approaches, in effect, attempt to establish a dedicated multimedia LAN, something that few network managers can afford.

Not all shared media LANs are unsuitable for multimedia: FDDI, FDDI over copper, and 100VG-AnyLAN all incorporate facilities that make it possible to

assign higher priorities to delay-sensitive traffic.

As mentioned, FDDI and its copper counterpart use a token-passing scheme to determine network access. The token travels around the FDDI ring, stopping at each station to give it the opportunity to transmit data. If enough stations use the token, network traffic can be delayed.

But FDDI also defines a way to implement synchronous services. Synchronous FDDI (on both copper and fibre) uses a timer to reserve a portion of the bandwidth for delay-sensitive communications. In effect, the timers limit how long each asynchronous station can transmit data while allowing synchronous stations to transmit up to their allocated bandwidth. Synchronous FDDI reduces the average node-to-node delay on FDDI and FDDI over copper networks from 200 milliseconds to 8 milliseconds.

(Note: The IEEE 802.5 4/16Mbps Token Ring standard defines synchronous prioritisation facilities similar to those specified in the ANSI FDDI standard. IBM is the only vendor currently implementing synchronous Token Ring; it launched its LANstreamer MC 16/32 synchronous Token Ring PC adaptor last June for use with multimedia applications).

100VG-AnyLAN also allows delay-sensitive traffic to be treated as high pri-

Table 2: Where The Action Is

VENDOR	CORE PRODUCTS	ATM	FDDI	FDDI OVER COPPER	FDDI II	FFOL	FIBRE CHANNEL
ACE/North Hills Elect. +1-913-888-4999	Hubs						
Cabletron Systems (02) 878 5777	Hubs	*					
Chipcom Corp. (02) 416 0653	Hubs	1994					
Digital Equipment Corp. (02) 561 5252	Adaptors, hubs	1994					
Fibermux ADC (02) 975 1499	Hubs	3Q 1994					
Fibronics International Toren (02) 202 1920	Hubs						
Hewlett-Packard 13 13 47	Adaptors, hubs						
IBM 13 24 26	Adaptors, hubs	1994					
Interphase Corp. +1-214-919-9000	Adaptors	1Q 1994					
Lannet Toren (02) 202 1920	Hubs	1994					
Madge Networks DDP (03) 694 6711	Adaptors						
Network Peripherals +1-408-321-7300	Adaptors, hubs	1Q 1994					
Optical Data Systems Netland (02) 622 8505	Hubs	1Q 1994*					
Proteon (02) 955 8555	Adaptors, hubs	1994					
SMC (02) 241 2933	Adaptors, hubs						
Sun Microsystems (02) 413 2666	Adaptors	4Q 1994					1994
SynOptics (03) 853 0799	Hubs						
3Com (02) 959 3020	Adaptors, hubs	3Q 1994					
Ungermann-Bass (03) 693 8200	Hubs	1994					

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ority. To do so it uses a mechanism known as Demand Priority Protocol (DPP). With DPP, network access requests from workstations are forwarded to a central hub.

Workstations can signal the hub to indicate whether they're sending high or low priority packets. If two or more stations transmit high-priority traffic simultaneously, access is allocated in a round-robin fashion in the order that the requests are received. The latency for traffic transmitted by the first workstation is 121 microseconds; this delay increases by 120 microseconds for every workstation that subsequently accesses the network. Despite such in-

cremental increases, DPP should be able to handle interactive multimedia.

Priority-setting schemes can generally hold latency to a tolerable level, but delays still fluctuate depending upon the number of devices trying to access the network at the same time. This fluctuation causes video images to appear jerky and distorts the quality of audio signals. One solution is to equip desktop multimedia gear with memory buffers that collect video and voice frames as they arrive and deliver them in a smooth stream. But even then, some loss of quality will still be apparent to users. And this approach increases costs.

A Logical Leap

But expensive memory buffers are not the only way around variable latency. FDDI II, FFOL, and isochronous Ethernet divide network bandwidth into two logical parts. One is used for multiple 64Kbps circuits that carry time-sensitive voice and video. The rest of the bandwidth is used to establish a contention-based network for asynchronous data.

Network adaptors for these three standards reflect this dual approach and will come equipped with two sets of MAC (media access control) circuitry. One circuit

HIGH-SPEED LANS

HIGH-SPEED TOKEN RING	ISOCRONOUS ETHERNET	FAST ETHERNET 100VG-ANYLAN	FAST ETHERNET (CSMA/CD)	FULL-DUPLEX ETHERNET	SWITCHED ETHERNET	SWITCHED FDDI	SWITCHED TOKEN RING
				1Q 1994	4Q 1994	3Q 1994	3Q 1994
					1Q 1994		
		1Q 1994			4Q 1994		
				1Q 1994			
		1Q 1994		*	*		
			2Q 1994		*		
			2Q 1994		*		
			1994		1995		

ATM = Asynchronous Transfer Mode FFOL = FDDI Follow-on LAN CSMA/CD = Carrier Sense Multiple Access/Collision Detection
 * Via OEM agreement with third party

multiplexes time-sensitive traffic from the workstation onto the LAN; the other circuit transmits asynchronous packets.

Because video and voice are carried over the network in circuits (or streams), delays are not only low but also constant — 125 microseconds for FDDI II, 5 milliseconds for FFOL, and 100 milliseconds for isochronous Ethernet.

100Mbps CSMA/CD is the only high-speed, shared media technology that does not support either prioritisation or multiplexing of time-sensitive traffic. Because it retains the CSMA/CD protocol used in conventional Ethernet, it cannot distinguish be-

tween different types of traffic. Simply said, all it cares about is resolving contention; it doesn't look inside the packet to see what type of data is being carried. Nevertheless, backers of the standard are adamant that 100Mbps CSMA/CD can be used for multimedia. The standard's backers assert that delays over 100Mbps CSMA/CD networks (said to be variable to a maximum of 30 milliseconds) can easily be handled by memory buffers.

All of the foregoing schemes help make shared media LANs better suited to multimedia traffic. But switched LANs remain the best vehicle for time-sensitive traffic,

since they eliminate contention entirely and establish multiple paths between workstations. Because ATM switches process short, fixed-length cells (rather than the long, variable-length packets used with all other LAN technologies) they easily meet the latency requirements of delay-sensitive traffic. Vendors estimate typical node-to-node delays on an ATM LAN at 20 to 30 microseconds.

Promoters of Fibre Channel claim it could deliver even less delay than ATM — some say around 10 microseconds. HP is working on a Fibre Channel switch. The high performance of the technology is at-

Table 3: Technology Trailblazers

VENDOR	TECHNOLOGY	PRODUCT	DESCRIPTION	AVAILABILITY
Accton Technology Group +1-510-226-9800	Fast Ethernet (100VG-AnyLAN)	Centium	ISA adaptor, hub	1Q 1994
Alfa Inc. +1-508-790-6901	Synchronous FDDI	FDDI-Sync	EISA, ISA, NuBus, SBus adaptors	Now
Ancor Communications +1-612-932-4000	Fibre Channel	6250	EISA, HIPPI, MCA, NuBus, VME adaptors, switch	Now
Grand Junction Networks +1-510-252-0726	Fast Ethernet (CSMA/CD)	Fastswitch 10/100	EISA adaptor, hub	Now
		Fastnic 100		Now
Hewlett-Packard 13 13 47	Fibre Channel	UFE-4	Switch	2Q 1994
Microaccess Inc. +1-408-257-8790	Fast Ethernet (CSMA/CD)*	OptiLAN HSTP 100 System	EISA and ISA adaptor, hub	Now
* Works only over six-pair UTP HPPI = High Performance Parallel Interface				

tributed to the design of Fibre Channel adaptors, which do most of their processing using hardware, rather than the slower, software-based drivers employed in conventional LAN adaptors. No independent testing of Fibre Channel products has yet verified such claims.

But one thing is certain: the Fibre Channel spec does not define a setup procedure for initiating switched multimedia sessions for delay-sensitive traffic. Net managers must configure dedicated links across network switches, which ties up capacity. The X3T9.3 committee is working on adding a switched multimedia session set-up procedure to Fibre Channel this year.

For the record, Fibre Channel's combination of low overhead, high throughput, and switched architecture make it the No. 1 solution for applications that require sustained, high-speed asynchronous communications — such as data storage, file transfer, medical imaging, and visualisation.

And by the end of this year, the IEEE may ratify yet another high-speed LAN standard that could handle the same data-intensive applications as Fibre Channel at some sites. P1394 (also known as High-Speed Serial Bus) features a shared media architecture that delivers very high data rates (possibly to 400Mbps). The catch is that P1394 nodes can be located (on average) no more than 4.5 metres apart. What's more, the standard mandates the use of six-pair shielded copper cable. P1394 is being pushed by Apple and IBM, who are recommending it primarily for peripheral sharing.

Plug and Play?

Performance issues aside, how well a high-speed LAN technology fits with the Ethernet or Token Rings already in place is a very important consideration. Most companies will deploy high-speed connections where they're needed most, leaving the rest

until later — so compatibility is crucial. This compatibility can be gauged in two ways. First, will the equipment conforming to the new standard trade traffic with the gear already installed? Second, will the high-speed standard run over the cabling now in place?

Because the new fast Ethernet standards (100VG-AnyLAN and 100Mbps CSMA/CD) both use the same packet format as 10Mbps Ethernet, it's relatively simple to mix them with their slower predecessor. An inexpensive hardware module equipped with memory buffers installed in either a hub or a router should do the trick.

Conversely, FDDI, FDDI over copper, FFOL, ATM, and Fibre Channel all require some sort of frame conversion to work with existing LANs. And memory buffers will again be needed to handle the different data rates.

In the long run, however, ATM and Fibre Channel will pay dividends. Because both standards are scalable, net managers could use them to build multi-speed LANs from a single technology, without having to install equipment to convert between different frame formats — in turn simplifying management, boosting performance, and cutting support-related costs.

The group responsible for FFOL is also looking to develop a scalable technology. And some supporters of 100VG-AnyLAN say it too will be scalable. 100VG-AnyLAN runs at 100Mbps over Category 3 UTP, but it could easily run as fast as half a gigabit on Category 5, according to a HP spokesperson.

However, asynchronous transfer mode is the only technology that can be scaled from the local area to the wide area (even globally). It owes this ability to its roots in telecommunications. At some point ATM should make it possible to base the entire enterprise on one technology.

But what about cabling compatibility? Choosing a high-speed LAN that can work with the copper cables, patch panels, and connectors already installed — rather than requiring better-grade copper or fibre — is an easy way for network managers to eliminate one of the biggest expenditures on the path to higher performance.

The Copper Standard

Thus, 100VG-AnyLAN's ability to ship data at 100Mbps for 100 metres using Category 3 UTP (unshielded twisted pair) and connectors (as well as higher-quality cables and connectors) is its key selling point. (100VG-AnyLAN accomplishes this without exceeding US FCC recommendations for electromagnetic radiation by sending signals over four copper twisted pairs; 10Mbps Ethernet uses two pairs). Isochronous Ethernet, which runs at 16Mbps, also works with Category 3 UTP.

Similarly, FDDI over copper can hit 100Mbps over Category 5 UTP. And copper is much easier to install and maintain than the 62.5/125 micron multimode fibre specified for FDDI.

Proponents of 100Mbps CSMA/CD say the spec will define different encoding schemes for different types of cable — including Category 3 UTP.

The ATM Forum, looking to accelerate the acceptance of its technology, is now working on low-speed implementations of the standard that will run over Category 3 UTP from hub to desktop. Two proposals are under consideration. A 25Mbps offering is being pushed by IBM; a 52Mbps offering is being touted by AT&T Microelectronics and AT&T Bell Laboratories. A decision on whether to ratify one of both proposals is expected early this year. The Forum is still working on an encoding scheme that will allow 155Mbps ATM signals to be transmitted over Category 5 UTP. ATM trans-



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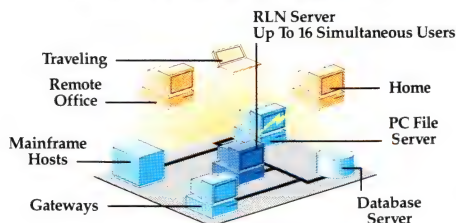
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missions at 622Mbps and above will require fibre.

Neither the FDDI II nor FFOL can run over copper. It's not yet known what type of cable will be specified for high-speed Token Ring. Fibre Channel works with a variety of copper cables, though transmission distances depend upon the combination of line speed and media. Thus, the standard defines a maximum distance of 25 metres for 1Gbps traffic over thick coaxial cable but extends that to 100 metres for data travelling at 133Mbps. The spec also states that STP (shielded twisted pair) should not be used above 266Mbps; UTP cabling is forbidden at all speeds.

Finally, it should be noted that while the ability to work with copper cable makes it easy (and inexpensive) to move to a higher-performance standard, such compatibility usually comes at the cost of restricted drive distance (typically, a maximum of 100 metres is allowed). For example, 100Mbps CSMA/CD over copper can support a network 250 metres in diameter, making it a good choice from the wiring closest to the desktop but precluding it — at least without repeaters — from serving as a campus backbone.

In the Money

The cost of deploying a particular LAN technology is not just a matter of cabling. In general, the standards that are being developed from scratch — ATM and Fibre Channel — will cost more to implement than ones that allow vendors to draw upon years of experience (such as 100VG-AnyLAN and 100Mbps CSMA/CD, which are based on Ethernet).

When it comes to cost, FDDI benefits from having gotten there first, with recent price falls the result of the appearance of second-generation silicon from Motorola and National Semiconductor. Today's 155-Mbps ATM networks, in contrast, cost substantially more. Proponents of the two fast Ethernet proposals claim they can bring products to market for only two or three times the cost of 10Mbps Ethernet LANs — making price less of a barrier. It's too early to say exactly how much products for FFOL networks will cost, though it will undoubtedly be more than today's FDDI gear. Prices have not been established for high-speed Token Ring products.

Behind the Scenes

But no matter what happens in committees or working groups, none of the high-speed LAN technologies will gain mainstream acceptance without the patronage of the heavyweight equipment vendors (see Table 2 on page 66). Right now, FDDI — which was ratified in 1990 — is clearly out in front. Over one hundred vendors currently sell FDDI equipment, including all the major intelligent hub and router vendors.

Gear for FDDI over copper also is starting to ship in quantity.

There's little doubt that ATM will one day be available from an equally wide range of sources. More than a dozen vendors are already shipping ATM switches or adaptors, and the list of signatories of the ATM Forum now numbers over 300 equipment suppliers.

Fibre Channel also has picked up some big backing: HP, IBM, and Sun all say they're planning products. More than 14 vendors have joined the Fibre Channel Association, an industry group promoting the standard. Market researcher Dataquest predicts revenues from Fibre Channel adaptors will climb from less than \$US2 million in 1993 to \$US1.2 billion in 1998.

Likewise, the 100Mbps CSMA/CD fast Ethernet standard has attracted support among some of the most significant vendors of 10Mbps Ethernet equipment, including SynOptics, which holds the largest share of the Ethernet hub market, and 3Com, which has a lock on the highest piece of the Ethernet adaptor market. 100Mbps CSMA/CD also has earned the backing of Sun, the No. 1 workstation vendor, as well as National Semiconductor, the leading foundry for Ethernet chips. The 100VG-AnyLAN standard doesn't want for fans either; 16 vendors now support the standard, and more are expected to announce soon.

Not all high-speed LAN standards have garnered this level of support: the FDDI II, FFOL, and high-speed Token Ring fan clubs don't exactly have a waiting list at the moment. And to a certain extent isochronous Ethernet also is suffering from the same lack of enthusiasm. IBM is the only major equipment vendor shipping isochronous Ethernet products. In fact, the proposed spec's biggest supporter is not an equipment manufacturer but a silicon supplier — National Semiconductor.

Some vendors, notably Apple, are playing a waiting game, holding off from giving their users a firm commitment to new LAN standards until they see how the market shakes out. At press time, Apple was unwilling to say that it will definitely implement any of the new LAN standards or technologies — including ATM and FDDI.

Even without the blessings of ratification, though, some standards are already being implemented by startups looking to get a jump on their larger competitors (see Table 3 on page 68). And the waiting game may well backfire, since by the time nascent LAN standards are stable enough for equipment vendors to start building products, the ATM juggernaut will be that much closer, possibly curtailing opportunities.

This problem is particularly acute in the cases of high-speed Token Ring and FFOL. Both are still at least two years away from any sort of stability. The high-speed Token Ring study group was only set up by the

802.5 committee last July. Its object is to extend the Token Ring MAC layer to higher speeds. The first proposals for such a standard were heard at a meeting of IEEE 802.5 in September. At that time, Proteon reportedly proposed using the same signalling and encoding defined in 100VG-AnyLAN to move Token Ring packets at 100Mbps. Sources within 802.5 indicate that another likely proposal will be to use FDDI signalling to carry Token Ring packets over fibre, also at 100Mbps.

Work on FFOL seems to have more or less petered out, possibly due to lack of interest from any of the major vendors. To date, the total output of the ANSI X3T9.5 committee that is preparing FFOL has been limited to one working paper, a slim tome about 20 pages long.

And to some extent, isochronous Ethernet also runs the risk of arriving too late to make any impact. A stable draft is not expected until the fourth quarter of 1994.

Other standards on the way to ratification should be finished up in time to make a mark before ATM arrives full force. Fibre Channel is now considered to be set, and it's unlikely that there will any radical changes before ratification later this year. FDDI II is expected to be wrapped up before the year is out. And stable versions of both 100VG-AnyLAN and 100Mbps CSMA/CD are expected in the first half of 1994.

But ratification is a beginning, not an end in itself. And even once vendors start shipping products, it takes time before equipment from different sources is fully compatible. In some cases — ATM, Fibre Channel, and 100Mbps CSMA/CD — vendors are banding together to speed interoperability.

That's not a problem with FDDI. The standard has been around long enough for most of the kinks to have been worked out. And for network managers looking to build a fully interoperable, high-speed, multivendor LAN today, FDDI is the only answer. FDDI's position as the only standards-based high-speed LAN currently available has led to a whopping increase in sales. Cabletron reports exponential growth of new installations, while National Semiconductor is predicting a five-fold increase in sales of FDDI adaptors between 1993 and 1994, based on advance orders for its FDDI chip sets.

Some of this new-found popularity also can be traced to the imminent ratification of the FDDI over copper standard, which puts 100Mbps on Category 5 UTP and STP. The spec is far enough along that 13 vendors were able to get together in Boston in June last year at an event organised to demonstrate product interoperability.

Stephen Saunders is the local-area networks editor for Data Communications magazine. He is based in the United States.

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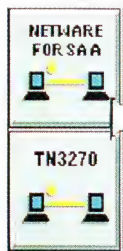


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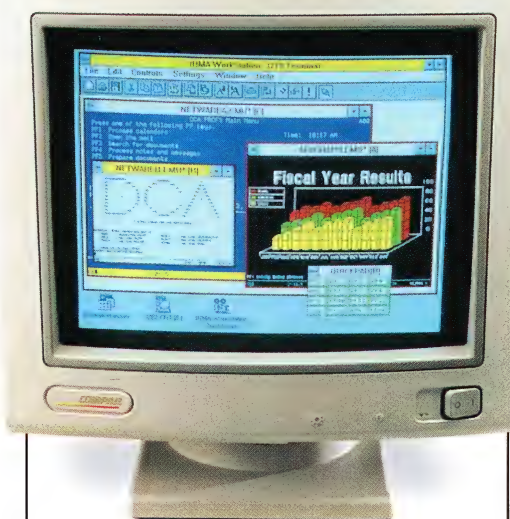
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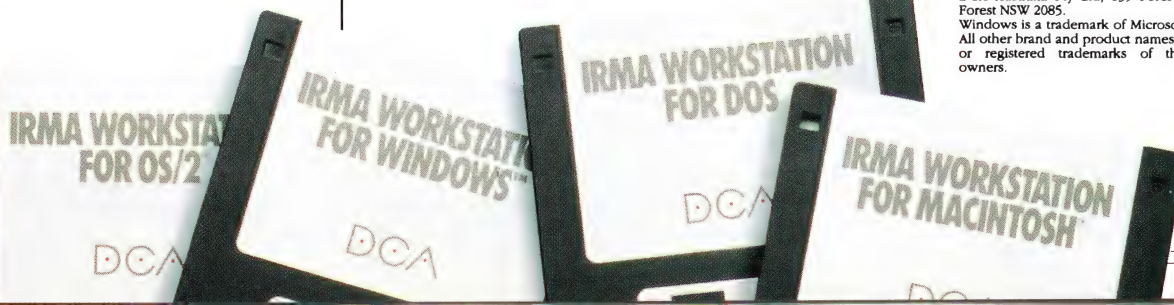
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AusComms Buys a WAN III — Part #2

Part #2 of our third annual look at WAN design, Graeme Le Roux examines solutions to AusComms' set of requirements proposed by Datacraft, JNA and Ungermann-Bass.

In this second and final part of our third annual WAN design project we present responses from network vendors Datacraft, JNA Network Services and Ungermann-Bass (see last month's edition for the first part of this article where we presented solutions from 3Com, Digital, GEC Alsthom, MPA International and Toren Computer Communications). These responses represent several different approaches to meeting AusComms' business needs. JNA's response is a pure internet based on TCP/IP and which assumes Unix hosts, though any host capable of TCP/IP communications would work as well. Datacraft has made the assumption that the traffic figures given are directly proportional to the number of PCs at each site, which has resulted in its model of traffic flow differing significantly from those used by other respondents.

In addition, we also present a solution from Moresdawn Pty Ltd and — as an exercise in flag-waving — a solution based on a much Australian content as possible. Moresdawn is the network consulting firm which prepared the Request For Information (RFI) for AusComms (our fictional company) to which our eight participating vendors responded. Because Moresdawn also analysed and commented on each of these responses we thought it only fair that the firm should also put its own solution up for analysis. Our Australian solution presents an interesting perspective on this country's IT industry. In spite of the fact that we spend millions on IT each year and are capable of producing leading edge hardware and software technology, we still don't have a manufacturer of a chassis-based hub, Ethernet switch or an Ethernet-to-Ethernet router.

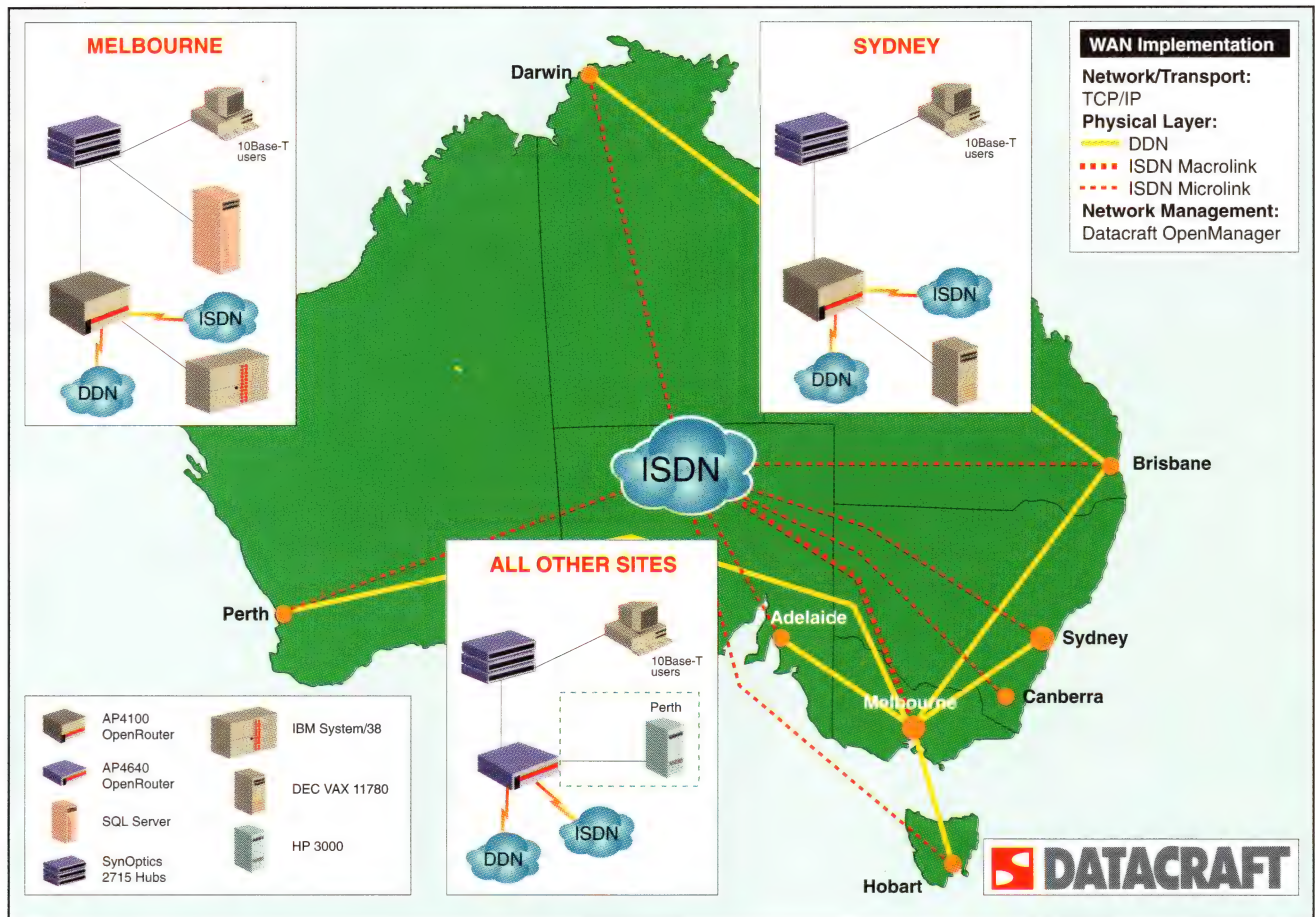
Datacraft

Datacraft Ltd is Australia's largest and one of our oldest communications equipment manufacturers and distributors. In the last financial year approximately half of the company's \$100 million revenue was the result of exports. Datacraft has a partnership agreement with Telecom Australia via Telecom's Enhanced Distribution Channel scheme and for this response the company has called upon Telecom to evaluate its recommendations regarding the telecommunications services which are proposed. As a result, Datacraft's response included a detailed submission from Telecom which includes an overview of Telecom equipment to be deployed, service details, costs and error performance; all of which supported Datacraft's assertions regarding the price performance of its proposed system.

Being a company which supplies only communications equipment and related services, the scope of Datacraft's response is res-



tricted to WAN connectivity based on its own AP4000 OpenRouters (see 'Datacraft Opens Up Routing,' in the June 1993 edition), Datacraft's OpenManager software, its recommendations regarding third party LAN transmission systems products and software from Isocor and WallData which Datacraft distribute. As is shown in the accompanying figure, Datacraft's solution differs from the bulk of the responses received in that it uses Telecom's Digital Data Network as a foundation for its proposed network and ISDN to provide



extra bandwidth during peak load periods. The reason for this difference is that the traffic flow model Datacraft used is slightly different from that used by other respondents. Both models are equally valid as the RFI was deliberately ambiguous in this regard.

The RFI stated that: 'The traffic flow across the company's telecommunications links (aggregate of both host-to-warehouse and host-to-host) in any 24 hour period exhibits a normal distribution which is negatively skewed toward a peak of approximately 121Kbps at roughly 15:00 local time — i.e. the peak in Perth occurs about 2 hours after the peak in Melbourne. The mean value of this curve is roughly 84Kbps. Monitoring of host accesses indicates that this traffic is mostly (approximately 98%) due to placement of orders with warehouses and queries on stock availability between hosts, therefore it is anticipated that the gross nature of this traffic flow will not change with deployment of the new system. It would seem probable that the peak and mean traffic values will alter slightly resulting in a 'flattening' of this curve. Major changes are expected in the wide area traffic flow between the hours of 18:00 and 08:00 local time once the new system is deployed. Currently there is little or no traffic during these hours. With the deployment of a distributed SQL-based system and an enter-

prise e-mail system AusComms has estimated, conservatively, that wide area traffic during these hours will vary between 32-Kbps and 48Kbps.'

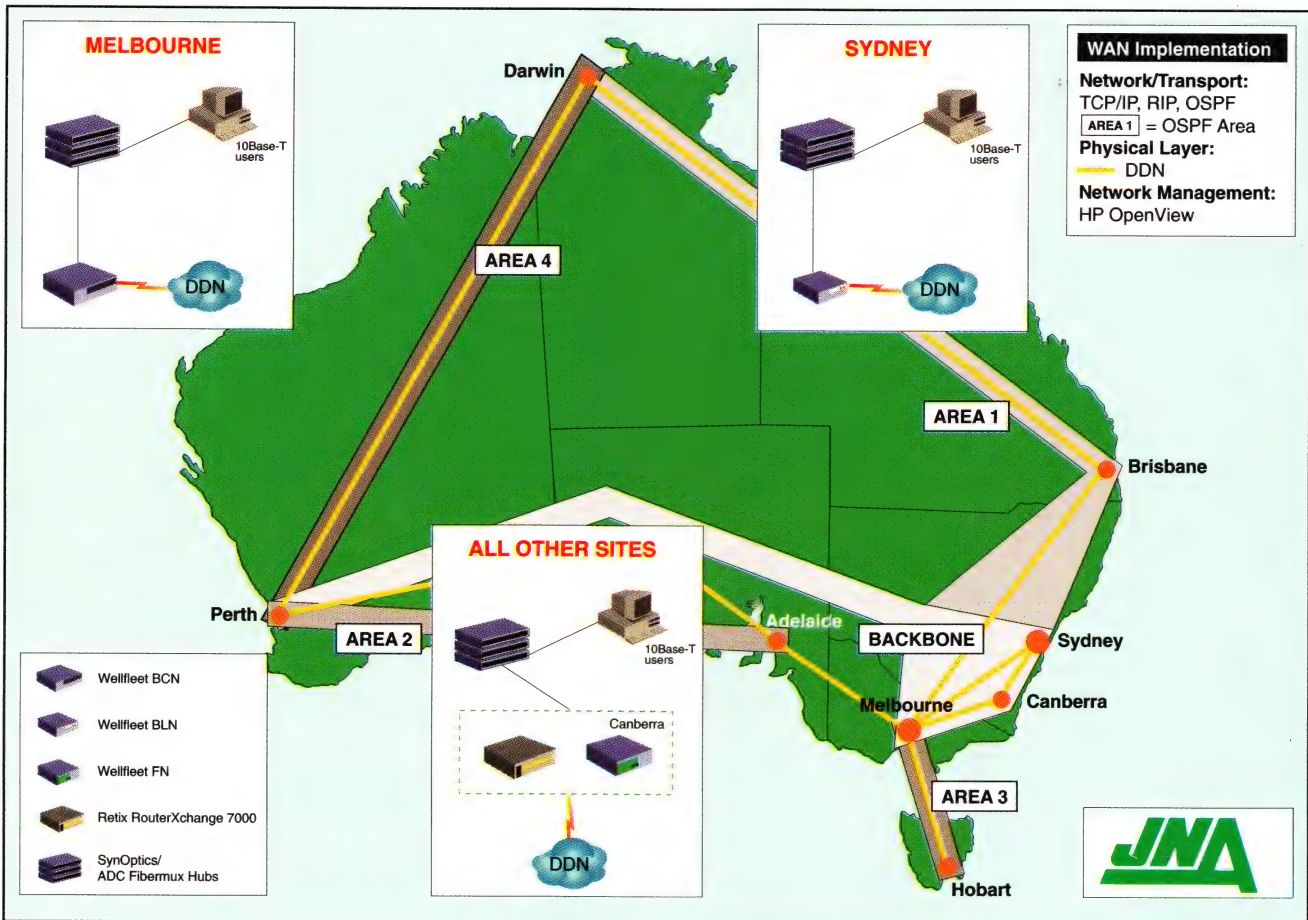
The key points here are that the given traffic flows are an aggregate figure; that the traffic flow is represented by a skewed normal distribution and that a flattening of the curve is anticipated. Datacraft has made the assumption that traffic levels are directly proportional to the number of PCs at each site; in other words a simple linear equation will give bandwidth required. The result is a constant traffic load of less than 48Kbps and a worst case peak of just over that figure. Given this traffic model, Datacraft's mixture of DDN and ISDN is a most cost effective option.

Without the assumption that traffic loads are directly proportional to the number of PCs at any site, linear relationships do not necessarily apply and therefore the traffic load on any link could best — i.e. most conservatively — be approximated by the peak aggregate bandwidth divided by the average number of links per site. Given a peak of 121Kbps divide this by 1.375 which is the average number of links per site based on current topography which equals a peak of 88Kbps per link. Allowing for the closure of the Darwin and Canberra warehouses which will increase traffic to Brisbane and Sydney respectively, and the installation of

SQL hosts in Hobart and Adelaide, this figure is reduced to just under a peak of 64-Kbps and the traffic is not constant. Most respondents have used variations on this model (hence the differences in WAN bandwidth allocation in the responses) and it must be stressed that either model is valid on the basis of the information given.

By using its AP4000 units Datacraft provides support for all possible protocols used by the VAX 11780 in Sydney and the HP 3000 in Perth. They also provide SDLC pass-through which would permit the existing System/38 and its cluster controllers to coexist with the new network. As is the case with solutions from 3Com, Digital and GECIT which were presented last month this is simply a consolidation of telecommunications channels to cut costs and not an attempt to integrate the System/38 into the new system. Datacraft's OpenRouters are also capable of acting as terminal servers providing either dial-up connections or connection for serial devices in warehouses. Datacraft has specified TCP/IP as the protocol of choice for the final system with OSI as an option, pending an assessment of its suitability.

WallData's Rumba software is suggested as a method of providing a common interface to AusComms' disparate hosts running on PCs equipped with a network interface and, where needed, a suitable 5250 em-



ulation card. Rumba differs significantly from the run-of-the-mill terminal emulation package in that, in its Windows version, it allows application-specific user interfaces to be written in Microsoft's Visual Basic. Datacraft points out that this might be an alternative to the immediate decommissioning of existing systems and that they would be happy to investigate this possibility with AusComms' EDP staff.

While it does not supply structured wiring systems, Datacraft is prepared to recommend cable installation specialists and recommends that a full Category 5 cable system including AT&T's Premises Distribution System be installed. Datacraft feel that this will provide AusComms with the most options for future standards. The company has also suggested that AusComms consider SynOptics LattisNet products to provide workstation connectivity within local LANs.

Datacraft's response makes no recommendations regarding workstations or hosts other than suggesting that AusComms should give preference to host environments which feature support of TCP/IP, OSI TP4, X.400 and/or FTAM. In the absence of any existing e-mail or electronic messaging system Datacraft has recommended that AusComms adopt X.400 (specifically the 1988 revision) as its company standard in this area and that Isocor's range of X.400

products be installed. These include Isopro which is a GUI e-mail menu system which runs on both PCs and Macintoshes and Isoplex 800 MTA which is an X.400 message transfer agent which acts as a mail server.

The Isoplex product currently runs under SCO Unix, SunOS, AIX, Sequent's Symmetry or Interactive Unix, and can use almost any network operating system protocol — e.g. NetBEUI, FTP's NFS, Novell, Banyan Vines etc. — for server-workstation communications. Isocor also has a fax gateway (Isifax), an EDI package called Isotrade which meets X.435/PEDI standards and an X.400 remote user agent called Isopro Remote which implements the P7 protocol for remote access to an X.400 Message Store. Isopro Remote is capable of using Asynchronous, X.25 or TCP/IP transports. There is also an X.400 Router for Lotus Notes which is a gateway which allows Notes servers to communicate via X.400 or Notes to send and receive to and from other X.400 host systems. Isopro software is compatible with any standard X.400 (1988) implementation.

Datacraft rounds off its response with details of its capabilities in the areas of project management, maintenance (including response time details), facilities management — specifically outsourcing of network management and training. The company also notes its capability, in partnership

with Telecom, to advise AusComms in the area of voice/data integration.

Comments:

Datacraft's AP4000 OpenRouters are arguably some of the best units on the market. They are particularly flexible in the area of bandwidth brokering — the ability to balance load, traffic characteristics and cost of service. They are also capable of providing DDN, ISDN and X.25 links concurrently. This would mean that, for example, in the event that AusComms decided to extend its X.400-based e-mail system beyond simple inter-office use — say to customers via AustPac — only minor upgrades, possibly no more than a configuration change and the installation of the new service by Telecom, would be required.

There are strong, and reasonably obvious, arguments for a standards-based messaging system, however the use of X.400 typically results in a significant administrative overhead and as a result AusComms or anyone else implementing it would have to perform a careful evaluation of any such proposed implementation — in this case Isopro software.

Datacraft's use of DDN as primary links and ISDN as backup/overload bandwidth also helps to ensure that latency across the system is kept within limits acceptable to the SDLC traffic between the Melbourne based System/38 and its remote cluster controllers.

In summary, Datacraft's response is carefully prepared, complete, efficient and elegant. It is also a response from a 100% Australian company. Datacraft Ltd can be reached in Melbourne on:

Tel: (03) 727 9111

Fax: (03) 726 5300

JNA Network Services

JNA Network Services' response is based on its philosophy of using open, standards-based solutions wherever possible. To this end it has suggested a system based on Unix hosts, OSPF routing zones and TCP/IP protocols running over Telecom's Flexnet access facility to its Digital Data Network (DDN). The cost effect of this approach would be assessed on the basis of the entire system as opposed to that of its individual elements.

JNA justifies its choice of Telecom's Flexnet on the basis that it combines DDN reliability with the capability of allowing the user to vary available bandwidth as required. This could, for example, permit AusComms to purchase high bandwidth during peak loads — say 12:00 to 17:00 — and low bandwidth overnight. JNA believes that this is the best option available to AusComms given that its requirements for system reliability and that precise bandwidth requirements are unknown.

Two possible WAN topographies were submitted by JNA; one which used an ISDN connection between Perth and Melbourne as a dial-on-demand back-up link combined with redundant Flexnet links, and a preferred option which is shown. As the accompanying figure on page 75 (which includes OSPF zone overlays) shows, JNA's proposed WAN topography has complete path redundancy for all sites except Hobart and the WAN is divided into five OSPF zones, one of which is designated as the system backbone. This backbone zone includes all sites with existing hosts and support staff. The division of the WAN into zones is critical to the efficient performance of OSPF. JNA also notes that since host-based routing may be required for interconnection of Unix-based SQL server hosts, support for other routing protocols such as RIP would be advisable.

As is the case with every response to AusComms' RFI, JNA has specified TCP/IP as the first choice for a network protocol. JNA has commented at length on the need to implement a carefully considered set of network naming and addressing conventions. It suggests that AusComms use its existing Class B internet address and assign a single octet as a subnet mask — an eight-eight split — and HP OpenView's option of an Ingress database engine be used to maintain configuration information across the entire system. A version of HP's OpenView which runs on a Unix workstation is JNA's sugges-

tion for an initial management platform. At a later date HP's distributed management version of OpenView would be deployed as needed. JNA suggests the use of NCD MCX colour X-Terminals as an initial platform for distributed management operations. It has also suggested the use of the ARS (Action Request System) trouble tracking system from Remedy Corporation.

JNA has specified routers from Wellfleet and Retix which would communicate via the point-to-point protocol (PPP, RFC 1171). Specifically, a Wellfleet Backbone Concentrator Node (BCN) in Melbourne, a Wellfleet Backbone Link Node (BLN) in Sydney and either Wellfleet's Access Feeder Node (AFN) or Feeder Node (FN) in Canberra. All other offices are to have members of Retix's RouterXchange 7000 family. The Wellfleet BCN/LN units differ only in the number of link modules with which they can be configured, their physical size and in that the BCN has fully redundant, hot swappable, power supplies while the BLN does not. Both units use Wellfleet's 1Gbps PPX architecture and have a system forwarding performance of 480Kbps. Both the Wellfleet FN and AFN units have a single WAN and LAN interface, a system forwarding performance of 14.5Kbps and are intended for deployment in remote locations where complete remote administration is required.

The smaller members of Retix's RouterXchange 7000 family are intended for similar applications. The Retix and Wellfleet routers interoperate via the point-to-point protocol, both support OSPF and SNMP management via OpenView. Within AusComms' offices JNA suggest the use 10-Base-T over category 5 UTP between desktops and hubs. JNA recommend either Syn-Optics or ADC Fibermux hubs.

The issue of access to existing hosts is carefully examined in JNA's response. The basic method of access is via workstations, to which all existing terminals would be upgraded, with appropriate software installed. JNA intends to upgrade the HP 3000 in Perth to allow direct connection to Ethernet. The company notes that the VAX 11/780 is already connected to Ethernet, but warn that if Digital's non-routable LAT protocol is in use then there will be 'dimensioning issues in ensuring that network latency is controlled to prevent time-out problems.' The IBM System/38 would be connected to a suitable gateway — Eicon is suggested — allowing workstations to access it via the LAN and the S/38 to use LAN printers.

Comments:

JNA's response was notable for an almost total lack of superfluous marketing hype. It was clear, concise and discussed all issues relevant to the RFI. The document was particularly note-worthy for its discussion of the necessity of a carefully planned addressing scheme and the not insignificant issue of timing problems in networks in which LAT (or

any other broadcast based protocol) and TCP/IP co-exist. This is a non-trivial issue as many a network administrator has learned the hard way. In fairness to the other respondents many of them mentioned this issue in conversation, but JNA were the only ones who put it on paper.

Another interesting feature of JNA's response is its WAN topography in which links have been designed to ensure redundant paths within Telecom's network. There is little point paying for a back-up link between, say, Adelaide and Perth, which goes through the same physical cable as your primary link. Farmer Fred with his back-hoe is not going to cut just your primary link. JNA's WAN solution is still susceptible to faults at the local Telecom exchange but there is no way to avoid this problem aside from using a VSAT link or some other form of non-cable dependant link (say a microwave link to the other side of town, then into Flexnet) but this would be expensive — probably unjustifiably so in this case. The same problem arises in telecommunications links to Tasmania. All links have to go across Bass Strait so there is no scope for redundancy beyond that which is inherent in the telecommunications system unless a private VSAT link is used. JNA Network Services can be reached in Sydney on:

Tel: (02) 417 6177

Fax: (02) 417 5837

Ungermann-Bass

Ungermann-Bass' response to AusComms' RFI was based around its Access/One hubs, Access/Stax Stackable hubs, Nile routers and ISDN Basic Rate services. System management is to be provided by UB's NetDirector system including an integrated performance measurement and protocol decode system (Network Control Series [NCS]) and an automated trouble-ticketing and service response control system (Paradigm). The preferred management protocol within the system is SNMP.

As is shown in the figure on page 78 Ungermann-Bass proposes to deploy Access/One hubs in Sydney, Melbourne and Perth. Each of these units would be configured with one supervisor (i.e. management) module, 10Base-T (24 port) and async (16 ports) as required, a network interface module (NIM) and dual port router modules as required. The async modules act as terminal servers. The supervisor module provides clocking (i.e. retiming) for 10Base-T modules along with management functions while the NIM provides backup retiming and a redundant backbone connection for the hub — presumably to the Net-Director stations. The Access/One hubs are also to be configured with fault tolerant power supplies.

The dual port router modules housed in the Access/One units and the Nile stan-

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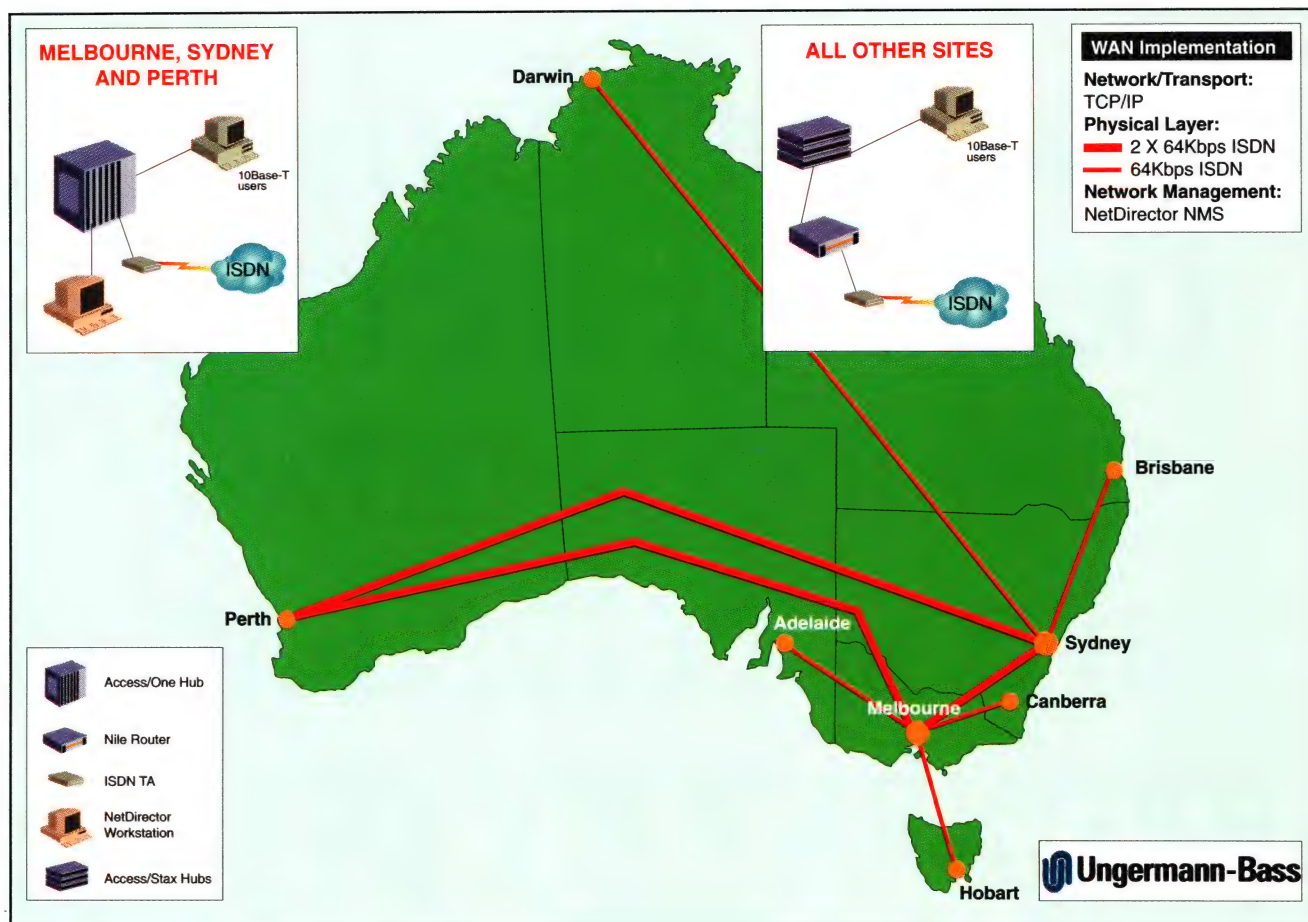
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alone routers which are to be deployed in Adelaide, Brisbane, Hobart, Canberra and Darwin are to be configured to handle one ISDN B Channel each. No ISDN TA's are specified and therefore the possibility of channel aggregation is not addressed. Ungermann-Bass suggests that on links where two B Channels are to be used that both channels be used in parallel rather than as a primary/secondary combination. The company points out that 'this approach requires [AusComms] to standardise on an appropriate routable/routing protocol (e.g. TCP/IP and OSPF)' and 'we [UB] feel it unnecessarily constrains [AusComms]' choice of applications software.' All UB's routers support OSPF, RIP, EGP and UB Enhanced RIP.

Sites at which Nile routers are deployed will also have Access/Stax stackable hubs installed. These units (at the time the UB response was written) are in 16 and 24 port configurations and both managed and unmanaged versions. One managed unit can manage a single stack of these devices.

UB's proposal assumes a UTP cable plant and notes the company offers 'a range of customised patch panels.' The company also offers its services in a variety of consulting capacities including traffic analysis, modelling of proposed applications, data flows and processing, project management, capacity planning and support. Ungermann-Bass also proposes that it prepares 'an

evaluation project' to provide AusComms with 'comparative demonstrations of available technology' in the area of voice/data integration.

Comments:

There are a number of issues which the Ungermann-Bass response fails to address satisfactorily; most importantly the traffic model upon which the company's recommendations regarding WAN bandwidth are based. Therefore the practicality and cost efficiency of UB's proposed configuration would be difficult to assess. Further, as pointed out above, UB does not suggest any particular type of ISDN TA and as a result the advantages of any advanced features of such units are not considered. This seems strange when UB recommends aggregating the ports at the router so as not to 'unnecessarily constrain [AusComms]' choice of applications software.' This is going to cost AusComms several extra routers.

UB recommended that a Network Interface Module (NIM) be added to each Access/One unit. This device has only two functions; to provide a backbone connection for, presumably, either management stations or other hubs and secondly, to provide retiming for 10Base-T modules. In the first place, the sites at which Access/One units are specified have only one unit per site and there is no indication that the NetDirector station need be plugged into anything but a 10Base-T port;

in the second, the NIM is simply covering poor design. Without a retiming module the hub is effectively dead, hence the Supervisor as primary and the NIM as secondary. With one exception there is no hub vendor which does not put retiming circuitry on, at least, each 10Base-T module and that one exception is an older design than the Access/One.

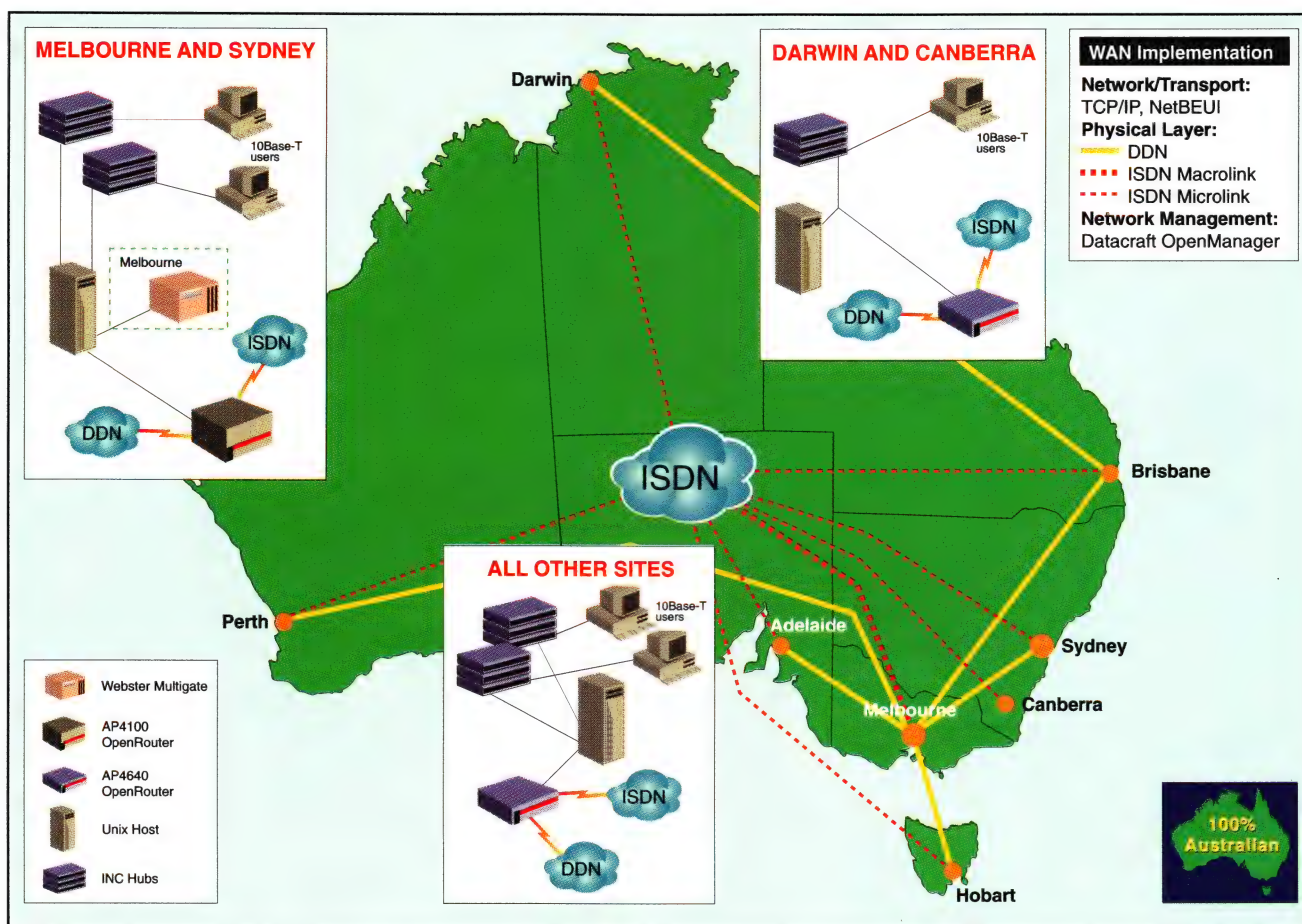
On the subject of 10Base-T (use of which is assumed) UB's proposal notes the company's ability to supply 'custom patch panels' however no specifications are provided therefore whether they are category 5, as per AusComms guidelines, is unknown. If they are not then there is no justification for a departure from those guidelines given as was clearly required.

UB has been in business for some years and its products could certainly provide for AusComms' business needs. However, on the basis of the information contained in its response to our RFI the quality and cost of that solution is difficult to assess. The company can be reached in Melbourne on:

Tel: (03) 696 2006
Fax: (03) 696 6483

A 100% Australian Solution?

With the notable exception of products from Datacraft and Jtec all the products which have been specified in response to



AusComms' RFI have been designed and built overseas. Is it possible to build a network system as required by AusComms with a reasonably high Australian content?

The definition of 'Australian Content' is as slippery as the concept of 'Australian Made'; for example, what is the Australian content of a device which is designed and manufactured in Australia from components which are imported? To simplify things we adopted two broad criteria: how much of the purchase price of the device remains in Australia; and how much of the cost of ownership of that device remains in this country? It is on this basis that this response to AusComms' RFI has been developed. The design proposed would work, it would fall within AusComms' guidelines and it could be administered and maintained at an affordable cost. It would not be necessarily the most cost effective solution or the most efficient from a technical standpoint.

As shown in the accompanying figure AusComms' WAN links could be managed via Datacraft AP4000 routers (Australian designed, built, supported. Imported components). An alternative would be Jtec TAs (Australian designed, built, supported. Imported components.) and Network Dynamic's ACE Routers from Interlink Communications (New Zealand designed, Australian built and supported. Imported components). Management would have to be via Data-

craft's OpenManager software in either case. OpenManager is an OEMed version of a product from US-based NetLabs.

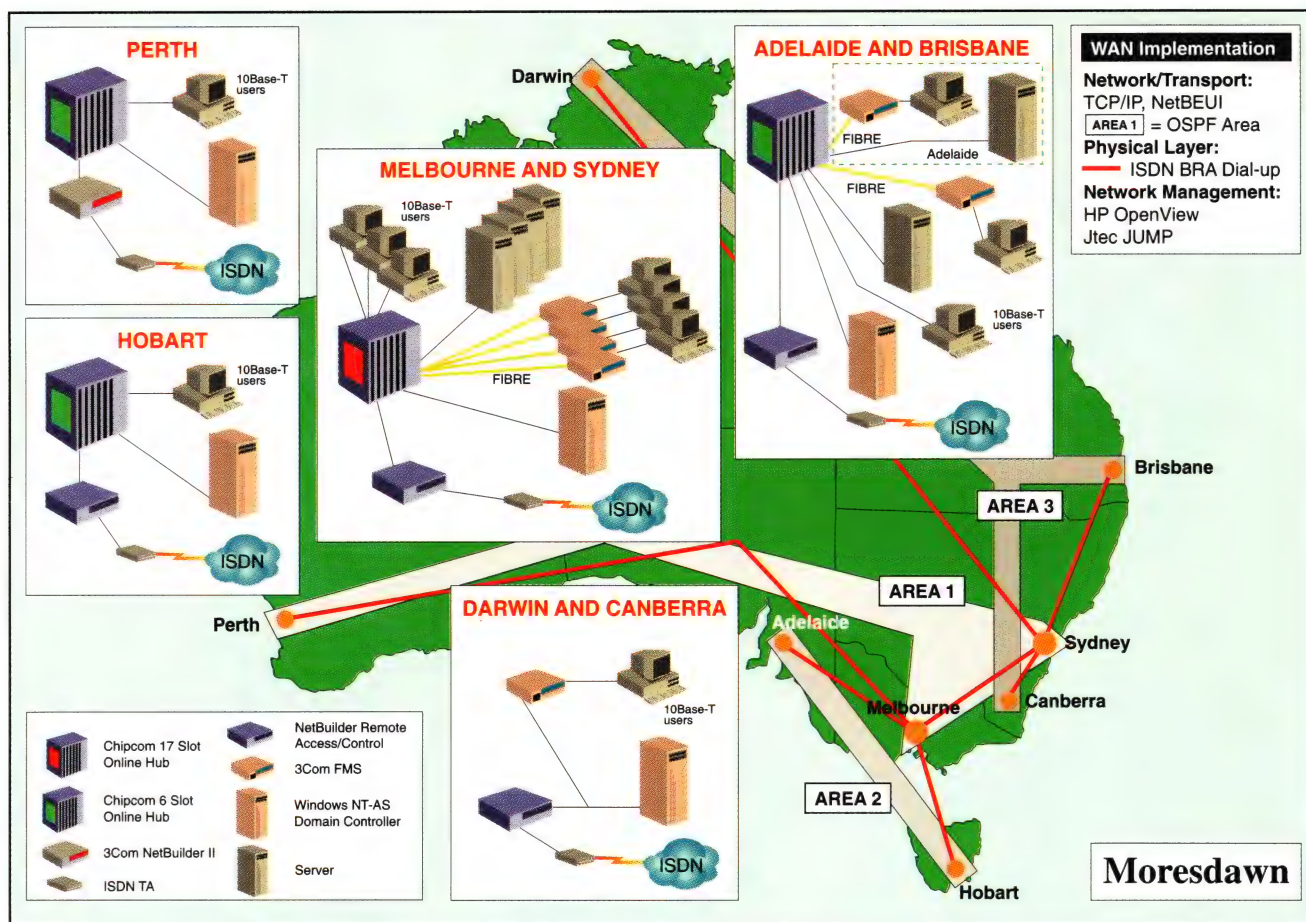
In AusComms' LANs INC's stackable 10Base-T hubs provide workstation connections. INC also make a range of network adaptor cards, including PCMCIA versions. INC does not make a NIC for Apple's Macintoshes, however Webster's excellent Multigate permits connection of AusComms' small number of Macs to an Ethernet. Some of the cable, connectors, patch panels, etc. required to interconnect these units may be imported, but the rack mount cabinets in which much of this equipment might be mounted can be sourced locally as can uninterruptable power supplies and line conditioners.

As for workstations and servers, there are several companies assembling machines from imported components. Since much of the cost of these units is in Australian labour, taxes and excise on components they have a reasonably high Australian content. Due to the complete lack of an Australian chassis-based hub, Ethernet switch and/or local bridge/router, multi-homed hosts (i.e. multiple NICs) are required to segment the network and control traffic flow. The only way this can be done is to deploy multiple Unix hosts with software routers. These would have to be running SCO Unix or the like. There are no Australian operating sys-

tems unfortunately, but there are a number of suitably high performance PCs available from local companies. Workstations would require imported TCP/IP software. Happily, the core system AusComms requires could almost certainly be written in Australia by Australians from scratch.

The main drawback with this system is the amount of administrative overhead required. Each site would have one or more Unix hosts, each of which would require the same level of administrative attention as any one of AusComms' existing hosts; further, each one of these units would be acting as a router. The whole system would be a relatively complex internetwork necessitating a complex system of sub-nets and a reasonably high level of user literacy. Setting up the system would also present a challenge, aside from the significant task of modelling a totally asynchronous traffic flow and finding the optimum configuration for hosts and AP4000s to handle that traffic flow, there is the question of compiling several different SNMP MIBs into some form of consistent management regime based on OpenManager.

In short, there are many excellent Australian products available to the system designer, however Australia's IT product range lacks several basic devices required to match international competition across the board.



Moresdawn

Moresdawn is an independent consultancy which provides network design services, technical oversight of network related projects and general networking expertise to project teams designing and building software systems which are to run on network platforms. The firm does not provide first line support or sell hardware or software.

Moresdawn's response was roughed out during the process of producing the original RFI primarily to test the RFI and gauge the amount of effort which we were asking vendors to put into their responses. Obviously there is a practical limit to the amount of effort that any organisation can be asked to put into a project like this without payment.

The final take on Moresdawn's response was made after all other responses had been submitted which gave it some advantage. The primary goal of the design described here is to provide a practical system that is tailored to AusComms' specific operational needs, will provide a return on investment consistent with AusComms' guidelines and has a cost of ownership which is as low as possible.

AusComms' warehouses operate as independent entities under central management control and each warehouse serves one or more sales groups which may be local or remote to the warehouse's physical

location. The RFI indicates that any sales group's relationship to a warehouse is exclusive. This implies that there is no business requirement for any user, other than those in support groups or sites at which there is no local warehouse, to access remote warehouses directly. Furthermore, the limited details of AusComms' operations which the RFI provides indicates that links between sales groups and warehouses need not be real time. Since the RFI indicates that warehouses have a vendor/client relationship with each other based on the location of any given product's manufacturer they must have the capacity to communicate over wide area links, however there appears to be no requirement for these links to be real time. Any future expansion of AusComms' operations, either locally or internationally, would also be unlikely to require real time links unless AusComms intends to alter the nature of its operations significantly. The RFI does not detail the mechanics of warehouse operations and therefore, since such information is not physically available, the assumption is that a PC-based system, which may include the use of barcodes, would suit AusComms' operational requirements.

On this basis Moresdawn recommends that AusComms' systems be built around a *messaging architecture*. The same messaging architecture would also provide enter-

prise wide electronic mail capability for general office communications, reporting, etc. It also permits a high degree of fault tolerance to be built into the system at relatively low cost.

As illustrated in the accompanying figure, users at each location are divided into one or more groups. No group contains more than half the users at any one site, except in Darwin and Canberra which are too small to divide. Each group contains no more than 22 users, one server and at least one printer. User PCs run DOS 6.2/Windows for Workgroups (hardware as per AusComms' guidelines) and communicate with the group's server via non-routable NetBEUI over 10Base-T and/or Fibre Ethernet standards. NetBEUI deployed at a workstation level, while generating significant broadcast traffic, results in a significantly lower administrative overhead than TCP/IP. Each group's server runs Windows NT-AS, including Mac Services in Melbourne, and controls its printer via the Data Link Control (DLC) protocol (direct serial or parallel connection is also possible).

These group servers, though apparently numerous, need consist of little more than an 80486-based PC with a hard disk and an adaptor card. The role of these servers is to provide user file storage, Messaging Application Programming Interface (MAPI) message transfer agent/service, group post



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office, printing services and a simple database containing stock levels, orders, etc. in the relevant warehouse. This simple database would be read only by user applications and updated periodically via MAPI from the warehouse domain controller. Backup of user files would be achieved via NT's file replication mechanism and a tape unit installed on the domain controller. Communications between servers and domain controllers is via TCP/IP, Chipcom hubs and 3Com servers. Domain controllers in each warehouse provide physical backup, via tape, for all data relevant to the warehouse in which they are situated, however their primary roles are as a database platform and a wide area MTA/S. Each domain controller periodically replicates changes in the data for which it is responsible such as stock levels, outstanding orders, account information, etc. to all other warehouses.

It is these multiple levels of replication coupled with the storage capability of a messaging architecture which gives the system its fault tolerance and an automated disaster recovery capability. If a warehouse is isolated from the system, operations continue with updates, orders, etc. automatically stored until that warehouse's domain controller becomes available, at which time data is automatically forwarded. This process is transparent to users and no data is lost. The same mechanisms allow transparent system recovery across a single LAN when group servers are isolated from their domain controller.

Assuming that group servers are set to write data to local domain controllers immediately (via MAPI) and that domain controllers update every 20 minutes across the WAN, then even the complete destruction of a site would result in, at worst, 20 minutes core system data being lost. In fact this might be reduced by including the export of an SQL transaction log (which would be cleared at the end of each update) in a server shutdown procedure. Another important effect of this system design is that all intra- and inter-domain data transfer is done on a scheduled basis, therefore traffic flow in the system, with the exception of management traffic, is deterministic. This makes capacity planning much simpler.

The transmission system requirements of this type of system differ significantly from those of a system based on real time data transfer. The system described above, while extremely tolerant of delays between data transfers, requires that any single transfer occurs reasonably quickly. For example, a domain controller update which consists of relevant changes only across a WAN link may consist of a couple of megabytes of assorted data. These updates may occur only two or three times per hour, and they can be delayed in emergencies, however once a transfer begins it cannot be permitted to take several hours to complete.

The most cost effective technology currently available to meet these requirements is a combination of switched Ethernet, collapsed backbones and high bandwidth, dial-on-demand WAN links — i.e. ISDN BRA dial-on-demand.

AusComms' guidelines require that 'under no foreseeable circumstances should a single site be isolated from the corporate WAN for more than 4 business hours in any one day.' It is Moresdawn's firm opinion that, even if all sites are equipped with totally redundant systems, including power and non-terrestrial communications links, that this requirement cannot be met — even at prohibitive cost. Moresdawn's experience is that, in general, it is more cost effective to accept the possibility that equipment at, and telecommunications links to, a site will fail and design a system which will tolerate as many probable faults as cost will permit.

Another important requirement of the platform for the proposed message-based system is the control of local broadcast traffic which results largely from the use of NetBEUI and the fact that the Windows Browser mechanism is broadcast-based — hence servers generate both NetBEUI and TCP/IP broadcasts. By deploying TCP/IP routers for WAN access NetBEUI is automatically confined to each site. Within each site control of broadcast traffic is achieved by the use of Chipcom's Online Ethernet Interconnect Module (OEIM, see 'Fast, Flexible Ethernet Router,' in the October edition) which is a switching router.

By setting the OEIM's custom filters to allow the switching of TCP/IP traffic only NetBEUI traffic is confined to individual groups while the necessary server-to-server broadcasts are permitted within each site. Being an Ethernet switch, the OEIM also provides concurrent paths for server-to-server sessions. This, coupled with the Online hub's unique management capabilities was the basis for it being chosen, in this instance, over the 3Com MSH.

3Com LinkBuilder FMS stackable hubs have been chosen over Chipcom's stackable units purely on the basis of cost efficiency. 3Com's Etherlink III and NB adaptors have been chosen for reliability, predictable performance in a Windows environment and configuration flexibility. The Etherlink adaptor's large number of configuration options will be required during the migration period when multiple NIC/Comms adaptors will co-exist in some PCs.

Chipcom provides a router module — actually an OEMed Cisco unit — which fits into the Online hub. While this option is physically neater than deploying external 3Com NetBuilders, Moresdawn considers that the 3Com unit's superior performance combined with its Boundary Routing System Architecture-based lower administrative overhead, makes it most appropriate to AusComms' needs.

The argument of lower administrative overhead also outweighed the reduction in capital cost and complexity which could be achieved by using Datacraft's AP4000 routers which would eliminate the need for Jtec TAs.

Moresdawn's proposal does not attempt the integration of existing hosts. Since the RFI indicated AusComms' intention to decommission its current system entirely, but did not provide details of existing host or client software, we would suggest — based on the assumption that this is physically possible — that, where necessary, the two systems be maintained in parallel for the six to 12 month migration period. This would imply existing workstation with host adaptors, StarLAN NICs, etc. running with dual adaptors and software. It would also require that, for the duration of the migration period some ISDN links be configured as semi-permanent and possibly the deployment of hardware to permit LLC tunnelling to existing S/38 cluster controllers. This would depend on the cost of such equipment compared to maintaining current telecommunications links. 3Com routers and Chipcom OEIMs are capable of handling TCP/IP, NetBEUI and DECnet/LAT environments concurrently.

Moresdawn Pty Ltd is based in Bundanoon, NSW and operates mainly in Sydney and Canberra. The company can be reached on: Tel: (048) 83 6812

Fax: (048) 62 2009

Real Life Winners

In summary, our third annual WAN RFI has proved that there is a high degree of technical expertise, customer service and a wide product range available to the would-be WAN/LAN buyer.

We have not attempted to declare a 'winning' response because of the artificial nature of the project. This was an imaginary company putting out an incomplete RFI. In a real situation each of the respondents would have spent a great deal of time on site filling in the technical blanks, talking or more importantly listening to the client and getting a feel for AusComms' business.

Responses would have been presented in much more detail than space permits in these pages and discussed in detail on site by the authors. After all this AusComms would have had the information necessary to write a solid tender, to which their short list of vendors would have been invited to respond. Only then could a real winner be chosen.

Once again we would like to express our appreciation to the staff of the companies which responded to the AusComms RFI for helping to make this project possible.

Graeme Le Roux is a Director of Moresdawn Pty Ltd (Bundanoon, NSW) and specialises in local area network consulting services.



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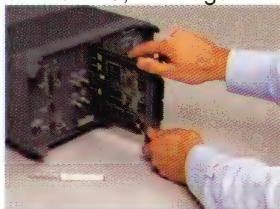
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ATM Networking Gear: Welcome to the Real World

Tall tales about seamless mesh networks carrying voice, video and data may make for sweet dreams but it's time to wake up and find out what first generation ATM networking gear can do today.

The trouble with easy answers is that they tend to make things more difficult for the people who raise the questions. ATM is a good case in point. When network managers ask for LANs that put the real back into real time or want to know where to find bandwidth to burn on the wide area, the stock response seems to be: 'Wait until ATM gets here.'

Let's get real: network managers are running out of patience, and even the most long-suffering among them realise that simply slicing and dicing data into 53-byte cells isn't going to make their troubles vanish. In fact, far from being an easy answer, ATM (asynchronous transfer mode) is turning out to be as complex as the problems it will ultimately solve. For one thing, determining exactly what ATM products will and won't do is no simple matter — especially with some equipment doing double or even triple-duty out on the network.

For another, net managers are learning that with ATM, it isn't so much a question of when as of where. The technology is likely to be deployed first on the campus, where it will furnish a fast, efficient way to connect LANs. True, ATM has already made it to some desktops, but the technology is probably going to be too costly and something of a case of bandwidth overkill on the average LAN for the next few years. And what about ATM on the wide area, where it will serve as the basis for private networks? Although this application has yet to garner the attention it deserves, the gear that's starting to show gives WAN managers a good shot at building bandwidth-efficient backbones.

None of this is to suggest that ATM's promise will go unfulfilled. The technology will change the face of networking — but not all at once. Some day, though, network managers will watch over a seamless mesh of ATM switches, routers, and time-division multiplexers. And on those networks, data, voice, and video will travel at anything up to multi-gigabit speeds.

But plenty of tough questions remain to be answered before ATM comes into its own. Incomplete standards must be fleshed out, particularly when it comes to critical areas like flow control and congestion management, LAN emulation, and network management (see 'ATM Specs: Present and Pending' on page 94). Interoperability must also be addressed: trade show demos are all well and good, but true plug-and-play compatibility lies months — or even years — in the future.

Did someone happen to say something about the trouble with easy answers? The place to begin is with the knotty problems that face the industry.



ATM on Parade

Probably the simplest thing to say about ATM equipment is that sales are strong and will continue to thrive: the Yankee Group predicts that US sales for ATM LAN equipment will go from \$US38.5 million in 1993 to \$US619 million in 1996. And switch manufacturer Fore Systems says the company has already sold over \$US12 million worth of ATM products since its equipment began

shipping in October 1992, predominantly to the desktop market.

In theory, ATM products can be neatly divided into two categories: switches and access devices. ATM switches are responsible for setting up calls between access devices, the same way that telephone switches set up calls between phones or PABXs. Access devices connect data terminating equipment (DTE) to the ATM network, and where necessary convert data into ATM cells.

So much for theory. Some products, it's true, are easy to classify: the Forerunner from Fore Systems and LattisCell from Syn-Optics Communications are pretty much straight ATM switches, connecting workstations equipped with ATM adaptor cards. But ATM routers, in contrast, can function as either switches or access devices. Some have ATM interfaces, which means they accept LAN packets, decide which port to send the data to, and convert it into cells if it's destined for an ATM network. Bear in mind, though, that the router is actually switching packets; data is reformatted into cells only at the interface. Thus, routers connect non-ATM LANs to an ATM network.

Or they do at the moment. Routers under development at Wellfleet Communications and other vendors will actually switch cells. (In other words, incoming packets will first be segmented and reassembled and then switched to the appropriate port.) Further confusing the issue is the fact that some vendors offer switches that include routing software; the aptly named Enterprise Routing Switch from Network Systems is one such product.

Where does that leave the attempt to classify ATM products? There are actually five types of equipment: campus and LAN switches, private network switches, routers, adaptor cards, and digital line terminating equipment (the latter are supplied by PTTs in most countries, but in the United States these devices — known as DSUs, or data service units — are sold by network equipment vendors).

It would probably help here to take a quick look at how some of this gear will be deployed (see 'ATM Everywhere' on page 87). Campus networks may be thought of as the backbone that links several LANs. The network is established by the switches, but obviously a way is needed to tie the LANs to it. There are three ways to do this. The switches themselves may have built-in LAN interfaces. It's also possible to use concentrators or hubs to make the link. Basically, these products connect a number of LANs to an ATM interface. Finally, routers can be used between a LAN and the switch. Private network switches come into play only on the wide area.

Campus switches are the cornerstones of ATM networks. These devices — such as the ATMx from California-based NET Inc.

ATM Uncovered

ATM's Cellular Structure

A 53-byte ATM cell includes a 5-byte header that specifies the virtual path and virtual channel over which the cell travels. The cell-loss priority bit indicates whether the cell can be discarded if the network becomes congested.

Byte	Bit 8	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1
0	Generic Flow Control				Virtual Path Identifier			
1	Virtual Path Identifier				Virtual Channel Identifier			
2	Virtual Channel Identifier							
3	Virtual Channel Identifier				Payload Type		Cell Loss Priority	
4	Header Error Control							
5-52	Payload							

The basic driving force behind the early development of ATM was the search for a switching technology that could support both voice and data. And the honours for first coming up with what would become asynchronous transfer mode go to researchers at AT&T Bell Laboratories, who got the job done in the early '80s. In essence, ATM is a version of cell relay that works with very short, fixed-length cells. This makes it possible to design switches with very low, fixed delays — important for carrying voice — that also are bandwidth-efficient when it comes to data. True, data can be accommodated on circuit switches; it happens every time a modem is used over the public telephone network. But circuit-switching data is wasteful: once a circuit has been set up, that bandwidth can't be used for anything else (whether or not data is actually travelling over the circuit). An additional advantage to ATM is that it allows cell switching to be handled in hardware. Packet switching, in contrast, is best done by software. Thus ATM designers can create very fast, cost effective equipment.

ATM calls for 53-byte cells — five bytes of header and a 48-byte payload. Such a short address space is possible because ATM is connection-oriented. In other words, a circuit is established through the network before cells are transmitted. Thus, each cell doesn't have to be individually addressed. In contrast, most packet-based schemes, including LAN protocols, require each frame to be individually addressed. ATM, in effect, associates each cell with the virtual connection between its point of origin

and its destination, either as a virtual path or virtual channel. Up to 65,536 virtual channels can be multiplexed onto a virtual path. A virtual channel also can stand alone, without being affiliated with a virtual path. Having both virtual paths and virtual channels makes it easy for a switch to handle many connections with the same origin and destination. Of the 40 bits in the header, eight identify the virtual path and 16 identify the virtual channel.

Connections are virtual by virtue of the fact that they don't use up bandwidth unless they are in active service, carrying traffic. They can be provisioned in one of two ways: either as permanent virtual circuits (PVCs), which are established by the network manager as part of the network configuration, or as switched virtual circuits (SVCs), which are established by the ATM devices themselves whenever they need to transmit data. Obviously, SVCs, don't require the same sort of configuration effort as PVCs; on the other hand, the standards for setting up SVCs have only recently been defined, and vendors have yet to implement them. That means it's not yet possible to set up calls between different vendors' gear.

ATM's ability to handle different types of traffic comes courtesy of the ATM Adaptation Layer (AAL). When the ITU-TS first came up with the concept of the AAL, the goal was to find a way to tell switches that they had to provide different types of service for different cells. Specifically, the switches had to recognise that some cells, such as those carrying voice, could not tolerate much delay.

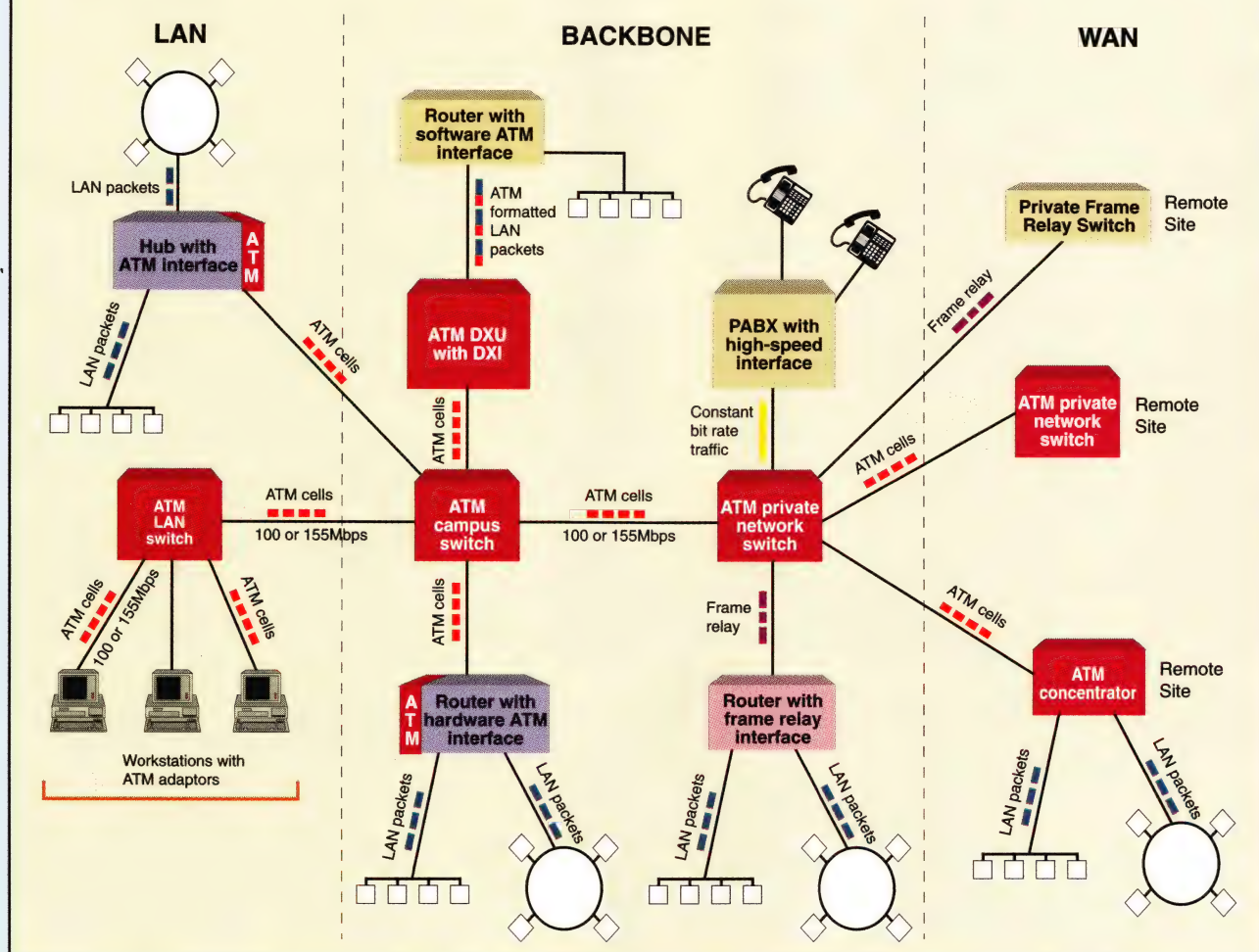
— typically transport LAN protocols such as TCP/IP and IPX, accepting ATM cells on one port and mapping them to an existing connection or creating a new one (see Table 1 on page 88). As mentioned, though, it's also possible to link LANs to an ATM backbone with concentrators such as the Vivid line from Newbridge Networks. The differ-

ence here is that concentrators don't accept native ATM traffic.

Private network switches, like their campus counterparts, switch cells. Yet these products, which include the 1100 HS from Alcatel Data Networks and the BPX from Stratacom, typically handle voice and older data formats such as SNA and X.25, as well

ATM Everywhere

Switches are the cornerstones of both an ATM backbone - which links several LANs - and of ATM LANs themselves. Some campus switches have built-in LAN interfaces, but it's also possible to use concentrators or hubs to tie Ethernet and Token Rings to a switch. Routers can also be used for this purpose. Private network switches link backbones to the wide area.



To this end, the CCITT came up with four AAL types. Type 1 allows for a connection-oriented circuit and constant-bit-rate traffic; it's appropriate for isochronous data such as video or voice. Type 2 also is connection-oriented but is intended for variable-bit-rate traffic, such as packetised video. Types 3 and 4 are similar enough to be combined (and are referred to as an AAL 3/4); they establish a connectionless circuit for variable-bit-traffic, such as LAN data. Although it would be logical to assume that since AAL 3/4 supports LAN-type traffic, it would be the AAL of choice for LAN switches, hubs and

adaptors. That's not the case, however. Various vendors came up with AAL 5 (since approved by the ATM Forum), which is easier to implement than any of its counterparts. Although not part of ATM's original feature set, it has gained the widest acceptance. Most ATM LAN gear supports AAL 5 (and possibly AAL 3/4), with support for other AALs left to the future. But even if an ATM switch can't recognise a particular AAL (and thus deliver the required level of services), it can still transfer a cell as it would any other. Despite the fact that ATM is a connection-oriented technology, it can handle both connec-

tion-oriented and connectionless traffic. Speed lies behind this sort of double duty: when a connectionless data packet is sent to an ATM network, the network reads the first cell of the packet and, based on the address in that cell, sets up a virtual connection almost instantaneously. The rest of the cells are forwarded over this connection. Once the entire packet has gone through, the circuit is torn down (if the network is using switched virtual circuits). If the ATM network uses permanent virtual networks, the circuit remains up but its bandwidth can be used elsewhere.

as LAN protocols (see Table 2 on page 90). What's more, private network switches often feature high-speed interfaces and support such wide area services as frame relay.

Routers can usually be classified by the type of ATM interface they use. In some products, this consists of software that formats LAN data into frames that can be

recognised by ATM DSUs. Other products work with a plug-in card that formats the LAN data directly into cells, obviating the need for a DSU-style device (see Table 3 on page 93). Some vendors have announced plans to develop an ATM switching card that will fit into a router, but no such products are available at the moment.

LAN adaptor cards are straightforward access devices. Most cards are sold by the ATM switch and hub vendors, such as Fore Systems and SynOptics, but suppliers like National Semiconductor and Interphase are moving into this market (see Table 4 on page 96). ATM adaptors generally work with only one vendor's switch. Right now

Table 1: Selected ATM Switches

VENDOR	PRODUCT	EQUIPMENT TYPE	MAXIMUM PORTS	ATM SWITCHING ARCHITECTURE/ THROUGHPUT	ATM INTERFACES
ADC Fibermux ADC Telecommunications (02) 975 1499	Atmosphere System Phase 1	ATM backbone and LAN switching hub	2 ATM, 4 dedicated Ethernet, 156 port-assignable Ethernet	Nonblocking/ 160Mbps	100Mbps UNI
	Atmosphere System Phase 2	Campus switch	50 ATM or 100 dedicated Ethernet or 12 WAN	Nonblocking/ 3.2Gbps	100Mbps and 155Mbps UNI
Fibercom +1-703-342-6700	EAS 8000	ATM concentrator	1 ATM or 4 FDDI or 48 10Base-T or 20 dedicated Ethernets	Nonblocking/ 90 Mbps	DS-3
Fore Systems +1-412-967-4040	Forerunner ASX-100 Switch	Campus and LAN switch	16 ATM, 2 LAN	Nonblocking/ 2.5Gbps	100, 140, 155Mbps over fibre; OC-3, DS-3 over cable; E3, T3
	Forerunner ASX-100 Switchcluster	Campus and LAN switch	64 ATM, 2 LAN	Blocking 10Gbps	100, 140, 155Mbps over fibre; OC-3, DS-3 over cable, E3, T3
GTE Government Systems +1-617-455-5182	Spanet 155 (Secure Prioritised ATM Network)	Campus switch	24 DS-3 (45Mbps), or 8 OC-3 (155 Mbps)	Nonblocking/ 1.2Gbps	DS-3 or OC-3 UNI, OC-12 (622Mbps)
	Spanet (Secure Prioritised ATM Network)	Campus switch	24 DS-3 or 8 OC-3	Nonblocking/ 9.6Gbps	DS-3 or OC-3 UNI, OC-12
N.E.T. +1-415-366-4400	ATMX	Campus and LAN switch	90 ATM	Nonblocking/ 1.2 Gbps	100, 155Mbps over fibre; DS-3, OC-3
Network Systems Corp +1-612-242-4888	Enterprise Routing Switch	Campus switch	15 ATM, 120 T1	Nonblocking/ 1.6Gbps	155 Mbps over fibre; DS-3
Newbridge Networks Datacraft (03) 727 9111	Vivid ATM hub	Campus and LAN switch	768	Nonblocking/ 2.4-12.8Gbps	100, 140, 155Mbps over fibre; DS-3, OC-3
	Vivid Yellow Ridge	Interface and concentrator	1 ATM, 12 Ethernet	Nonblocking/ N/A	100, 140, 155Mbps over fibre or Category 5 UTP
	Vivid Blue Ridge	Interface and concentrator	1 ATM, 8 Token Ring	Nonblocking/ N/A	100, 140, 155Mbps over fibre or Category 5 UTP
Optical Data Systems Netland (02) 622 8505	Infinity switching hub	Campus switch	8 ATM, 60 FDDI, 384 Token Ring, 576 Ethernet	Nonblocking/ 2.4Gbps	100, 140Mbps over multimode fibre; OC-3, T1, T3
SynOptics Communications (03) 853 0799	LattisCell Model 10102 ATM switch	Campus switch	16 ATM, (4 fibre, 12 STP)	Nonblocking/ 5 Gbps	155Mbps over fibre and STP
	LattisCell Model 10104 ATM switch	Campus switch	16 ATM	Nonblocking/ 5Gbps	155Mbps over fibre
Whittaker Communications +1-503-626-9000	Ignitor 155 ATM switch	LAN switch	16 ATM	Nonblocking/ 2.6Gbps	155Mbps over fibre

AAL = ATM Adaptation Layer N/A = Not available UNI = User Network Interface

they're available (or at least announced) for most high-speed workstations, including those from Sun and Silicon Graphics.

When it comes to DSUs, though, the distinctions between switch and access device once again blur. The earliest ATM DSUs available in the US had a single port interface and a single network interface; the only function these products performed was translating data packets into ATM cells. More recently, however, vendors have an-

nounced products with multiple port and network interfaces; some of these perform local ATM switching, meaning that they can switch cells from one local port to another as well as pass cells onto the wide area.

Campus Concerns

As indicated, most network managers are going to deploy ATM first on the campus, using switches to build a high-speed backbone. That makes comparing and evaluat-

ing products like the Forerunner and Infinity from Optical Data Systems the first order of business.

The place to begin is with basic features, such as capacity, throughput, interfaces, switching architecture, and management and control software (which makes it possible to establish virtual LANs). Although there's been a lot of talk about buffering, prioritisation, and flow control, so far the debates have not yielded much hard infor-

LAN INTERFACES	WAN INTERFACES	AAL TYPES	BRIDGING ENCAPSULATION	PRIORITISATION	VIRTUAL LANS	BUFFER SIZE	AVAILABILITY
Ethernet	DS-3, OC-3	5	Yes	N/A	Yes	N/A	2Q 1994
Ethernet, Token Ring	DS-3, OC-3	2, 5	Yes	Yes	Yes	N/A	2Q 1995
Ethernet, Token Ring, FDDI	DS-3, DS-1	5	Yes	None	None	N/A	Now
Ethernet, FDDI (for management)	DS-3, OC-3, E-3	1, 2, 3/4, 5	Yes	Yes	Yes	1MB per port	Now
Ethernet, FDDI (for management)	DS-3, OC-3, E3	1, 2, 3/4, 5	Yes	Yes	Yes	1MB per port	Now
Ethernet, FDDI, Token Ring, HPPI available via multi-LAN interface module	T1, OC-3, DS-3	1, 3/4, 5	Yes	Yes	Yes	N/A	Now
Ethernet, FDDI, Token Ring; HPPI available via multi-LAN interface adaptation module	OC-3, T1, T3	1, 3/4, 5	Yes	Yes	Yes	N/A	Now
Ethernet (for management); Ethernet, Token Ring and FDDI through gateway	DS-3, OC-3	1, 2, 3/4, 5	Yes	Yes	Yes	2MB - 30MB per port	Now
Ethernet, FDDI, Token Ring	OC-3, DS-3, sub-T1, T1, frame relay	3/4, 5	Yes	Yes	Yes	2MB per port	1Q 1994
Ethernet	OC-3, T1, DS-3	1, 5	Yes	Yes	Yes	51.75K per port	Now
Ethernet	OC-3	5	Yes	Yes	Yes	0.5MB per port	1Q 1994
Token Ring	OC-3	5	Yes	Yes	Yes	0.5MB per port	1Q 1994
Ethernet, Token Ring	DS-1, DS-3	1, 5	Yes	Yes	Yes	848 bytes per port	Now
None	None	1, 2, 3/4, 5	N/A	Yes	No		Now
None	None	1, 2, 3/4, 5	N/A	Yes	No	13.25K per port	Now
None	OC-3	5	N/A	Yes	Yes	13.25K per port	Now

mation. Switch capacity in this context refers to the number of ports supported. This is one place where scalability — one of ATM's great advantages — comes into play, since the technology allows switches to be added as necessary to the backbone.

SynOptics takes a hierarchical approach to capacity, designating one switch — the LattisCell 10104 — as a 'switch of switches' for attached 10102s. The 10104 can be configured with up to 16 ports.

Fore takes a similar approach. Its ASX-100 Switchclusters can accommodate up to 64 ports, which can be used to link the vendor's ASX-100 LAN switches. Both types of switches also can be concatenated.

Newbridge's Vivid ATM hubs are concatenated to form an ATM backbone (see 'ATM Comes Out of the Ether' in the May 1993 edition). The Vivid Yellow Ridge and Blue Ridge are concentrators for Ethernet and Token Ring networks.

Throughput is another important consideration. It typically ranges from 1.2Gbps — NET's ATMx — to 10Gbps — Newbridge's Vivid hub and Fore's ASX-100 Switchcluster.

All throughput is not created equal, however. Switch architectures can be either blocking or nonblocking. With the former approach, calls can be blocked — even if bandwidth is available at the switch. A non-blocking architecture guarantees that band-

Table 2: Selected ATM Private Network Switches

VENDOR	PRODUCT	SWITCHING THROUGHPUT	SWITCH ARCHITECTURE	MAXIMUM PORTS	ATM INTERFACES
Alcatel Data Networks Alcatel Australia (02) 699 0044	1100 HS	1.2Gbps	Nonblocking	29 ATM	100, 155Mbps over fibre; DS-3
Cascade Communications +1-508-692-2600	B-STDx 9000 Broadband Packet Internetworking ATM Platform	1.2Gbps	Nonblocking	14 ATM	DS-3, OC-3, UNI
General Datacom (02) 956 5099	Apex	6.4Gbps	Nonblocking	32 ATM, 64 Ethernet	T1, T3, E1, E2, E3, OC3, HSSI, X.21, RS449
Hughes Network Systems AAP Communications (02) 692 1015	ATM Enterprise Switch	2.5Gbps	Nonblocking	16 ATM (DS-3 or OC-3) or 128 T1	100, 155Mbps over fibre, 155Mbps over STP
Lightstream Corp +1-617-873-6300	Lightstream 2010 Enterprise backbone ATM Switch	2 Gbps	Nonblocking	71 T1/E1 or 18 T3/E3	ATM UNI at DS-3 and E-3
Northern Telecom NorTel (02) 428 8777	Magellan Gateway	1.2Gbps	Nonblocking	8 ATM (OC-3), 24 ATM (DS-3), or 32 ATM (DS-1)	DS-3 and OC-3 UNI 100Mbps fibre
Stratacom Digital (02) 561 5252	BPX	9.6Gbps	Blocking	36 T3/E3	ATM UNI at DS-1 and DS-3 speeds

AAL = ATM Adaptation Layer HSSI = High-Speed Serial Interface SDLC = Synchronous Data Link Control STP = Shielded Twisted Pair
 HDLC = High-level Data Link Control N/A = Not Available SMDS = Switched Multimegabit Data Services

width, if available, will be supplied. Blocking switches typically offer higher bandwidth than their nonblocking counterparts. A well-designed blocking switch, however, works hard to minimise the possibility that a call will be blocked. SynOptics' LattisCell, for example, is a blocking switch, but it uses a technique called 'randomised traffic distribution' to ensure that calls are rarely blocked.

Given that campus ATM switches must link to a variety of local area networks, net managers might assume that any switch worth its salt would support a variety of interfaces. They'd be right — sort of. ATM interfaces are available for everything from Sonet/SDH optical fibre to twisted pairs, but the most common interfaces are to 100 and 140Mbps over fibre. Data rates for twisted pairs have yet to be decided.

As this story went to press, the ATM Forum was considering two proposals. Despite the uncertainty, vendors are already implementing twisted-pair interfaces. SynOptics' new LattisCell can handle 155Mbps transmissions over Type 5 twisted pairs, but this sort of cabling has better noise and attenuation characteristics than the copper used for analogue phones. It's also more expensive.

Still, there are some surprising omissions when it comes to interfaces. NET only recently added DS-3 (a US 45Mbps standard) ATM to its ATMx switches to give them a way to connect to the wide area. Similarly, Fore's ASX-100 can't link to Token Ring and Ethernet, a significant shortcoming. It's true that the ASX has

built-in FDDI and Ethernet interfaces, but these are meant to connect to routers, not workstations. And Fore doesn't sell add-on interfaces for LANs.

The whole issue of legacy LANs poses a very real problem for most ATM switches. Local area networks must be either routed or bridged onto the ATM backbone. In the former case, traffic can be handled via a conventional router with an ATM interface. But the latter means relying on encapsulated bridging, and that translates into trouble.

There's currently no encapsulation standard for ATM, which means that proprietary schemes are the order of the day. Here's a quick look at the problem: if the bridge used to connect a LAN onto the ATM backbone works with a proprietary encapsulation scheme, nodes on that LAN can only communicate with nodes on the backbone when both use the same proprietary protocol.

Consider a workstation on a LAN segment linked to the backbone via an Ethernet-to-ATM bridge (the kind that many hub vendors are implementing). The workstation creates an Ethernet packet and addresses it to the server. The bridge picks up the packet, reads its 48-bit MAC address, and sees that the packet has to go out on the backbone. Not being a router, and therefore not knowing the route to the destination, the bridge simply multicasts the packet to every station on the backbone that it knows about.

But since the bridge is using a proprietary protocol, the only backbone nodes that receive the packet are other encapsulating bridges, so the packet never makes it to the server.

Three To Go

A working group within the Service Aspects and Applications subcommittee of the ATM Forum is now studying three proposals for LAN emulation, but a specification isn't expected to be completed for another year. Meanwhile, vendors continue to implement proprietary schemes.

At the moment, the only way around the bridging problem is to use one vendor's products or avoid bridging altogether and use routing instead. But that means that protocols that can't be routed — including LAT (Local Area Transport), NetBIOS, and IBM SNA LLC2 — can't travel across the backbone.

An ATM switch's management and control software also needs to be carefully considered. This feature has gotten a great deal of attention of late, since several vendors — among them ADC Fibermux and NET — are talking up their ability to establish virtual LANs.

The concept behind a virtual local area network is familiar to users of port-switching hubs, which allow network managers to create virtual workgroups of users who need access to the same resources (and to one another) but may not be connected to the same length of cable.

The big appeal of virtual LANs is that net managers can add, delete, and reassign users from a central console (merely by pointing and clicking a mouse). Without a port-switching hub, managers must physically disconnect and then reconnect the user's workstation.

OTHER INTERFACES	AAL TYPES	PRIORITISATION	BUFFER SIZE	AVAILABILITY
Frame relay, HDLC, SDLC at 64Kbps-2Mbps; SMDS from 2-16Mbps	3/4	Yes	N/A	1Q 1994
SMDS, frame relay and assorted data rates from sub-T1 to DS-3	1, 3/4, 5	Yes	52K per port	1Q 1994
Frame relay, Ethernet, and T1 and E1 through circuit emulation	1, 5	Yes	64K per port	Now
T1/E1, T3/E3, OC-3	5	Yes	Up to 512K per port	3Q 1994
Frame relay, frame relay forwarding for X.25, HDLC and SNA/SDLC at 56Kbps to E3	5	Yes	Up to 2.5MB per port	1Q 1994
DS-3 isochronous T1	1, 3/4, 5	Yes	56K input, 52K output	1Q 1994
Frame relay and a variety of data interfaces from 56Kbps to DS-3	1-5	Yes	1.24MB per port	4Q 1994

True, it's possible to implement virtual LANs with existing technologies, but ATM simplifies what would be a very difficult task and enables features that could not be implemented any other way. For example, ATM lets workstations belong to more than one workgroup at a time. Thus, users could simultaneously log onto, say, the engineering and marketing LANs — with full access to other end-users and resources of both. While it's possible to write software that maps an Ethernet or Token Ring MAC-layer address to more than one virtual LAN, doing so would be cumbersome. NET has implemented software that supports virtual LANs on top of its ATM switch. ADC Fibermux recently introduced a virtual LAN package also.

Effective management and control software also makes it possible to multicast to multiple logical subnets. With Ethernet and Token Ring, in contrast, a user can broadcast only to stations on the same LAN.

The Big Buffer

Buffering, flow control, and prioritisation also are important when evaluating ATM switches. Unfortunately, it's difficult to say much more than that at this point. Standardisation efforts for flow control are just getting under way. And the type of buffering and flow control that makes the most sense for ATM environments is still a matter of ongoing investigation.

For example, a researcher at Sun Microsystems set up a simulation in which TCP traffic travelled over an ATM network and over a packet network, using different-size

buffers for the switches on each. He found that small buffers were far more likely to lead to congestion on the ATM network, which suggests that even without a formal congestion management specification, network managers are well advised to look for the large buffers on their ATM switches (at least if they intend to transport TCP).

How much buffering is enough? It depends on the characteristics of the traffic, including packet size and TCP window size, but the simulation showed that 528-byte buffers worked well. Fore's ASX-100 has a 1MB buffer on every port; Network Systems' Enterprise Routing Switch features a 2MB buffer on each port.

As for prioritisation, again the best that can be said is that it's a good idea. In short, prioritisation allows users to define different types of service for different types of traffic: video, for instance, might be awarded a higher priority than LAN data because video signals are more sensitive to delay than file transfers.

Prioritisation is most important for gear destined for bandwidth-limited environments, such as private networks. Prioritisation schemes can range from two settings to far more ambitious approaches. Northern Telecom makes it possible to set eight priorities on its Magellan Gateway.

Router Realisations

As mentioned, there are two ways for a router to connect to an ATM network — via software or hardware. Among the software interfaces now available is the ATM data exchange interface (DXI), a specification

created by the ATM Forum that spells out how LAN packets are to be formatted so that they can be recognised by devices like DSUs. In other words, a router that supports DXI formats each LAN packet so that an ATM device knows where to find the addressing information and how to divide the packet into cells. Wellfleet, Cisco and Network Systems have DXI interfaces for their routers.

It's possible for a router to link to an ATM switch via frame relay, assuming the switch has a frame relay interface (commonly found on private network switches).

It's also possible for the routers themselves to perform the ATM cell segmentation and reassembly. This requires a hardware ATM interface; while nearly all router vendors say they'll eventually offer such interfaces, only a few — including Network Systems and Retix — offer them today.

Although most network managers are likely to first encounter ATM on the campus, those who need to link high-performance workstations are already investigating the technology on LANs.

Vendors — possibly hoping to encourage the wary — have started to cut the prices of some equipment. Fore Systems, for instance, late last year announced that its LAN adaptor cards would sell for \$US1,295 — down from \$US3,995. By 1995 between 20% and 25% of Sun workstations sold will come with ATM adaptors, according to Sun. These machines are a staple at most scientific and research laboratories, and 99% of Sun workstations are now sold with LAN adaptor cards.

Using an ATM LAN switch and its associated adaptor cards is the simplest way to deploy ATM on the local network. Ironically enough, however, ATM's major drawback on the LAN is one of its greatest assets elsewhere — bandwidth. The 10 to 16Mbps offered by most LANs is more than enough for the PCs on most users' desks. There's little reason to give a machine whose internal bus operates at 8 to 33MHz access to a network that runs at twice that speed (or more). And there's no way to justify the expense of a high-speed channel when the devices using it are inherently bandwidth-limited.

Just for the record, attaching an 8MHz PC to a 10Mbps Ethernet or 16Mbps Token Ring doesn't pose the same problem. In part that's because the performance differential is smaller. But the difference is mostly due to the fact that both Ethernet and Token Ring share the total bandwidth among all workstations. On an ATM LAN, in contrast, each station is furnished with the full bandwidth.

Making Movies

Multimedia is often touted as the 'killer application' for ATM, the application that will drive the sales of ATM gear the way

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Table 3: ATM Routers

VENDOR	PRODUCT	ATM INTERFACES	OTHER INTERFACES	AVAILABILITY
Cisco Systems (02) 957 4944	ATM DXI for Cisco 7000 Routers	DS-3 DXI	Ethernet, Token Ring, FDDI	Now
	Internal ATM UNI for Cisco 7000 routers	100Mbps and 155Mbps fibre UNI	Ethernet, Token Ring, FDDI	2Q 1994
Datacraft (03) 727 9111	AP4700 OpenRouter	Various interfaces planned	ISDN, Ethernet, Token Ring, Fastpac, DDN, X.25	4Q 1994
Network Systems Corp +1-612-242-4888	DXI interface for DX and DXE routers	DS-3 DXI	Ethernet, Token Ring, FDDI	2Q 1994
	Internal ATM interface for DXE routers	155Mbps (OC-3) fibre UNI	Ethernet, Token Ring, FDDI	2Q 1994
Retix (03) 563 4333	ATM Interface for RouterXchange router	100Mbps over fibre	Ethernet, Token Ring, FDDI	1Q 1994
Wellfleet Communications (02) 959 1290	ATM DXI Interface for Link Node, Concentrator Node and Backbone Link Node routers	DS-3 DXI	Ethernet, Token Ring, FDDI	1Q 1994
	Hardware ATM Interface for Link Node, Concentrator Node and Backbone Link Node routers	155Mbps (OC-3) over fibre UNI	Ethernet, Token Ring, FDDI	3Q 1994
3Com (02) 959 3020	Cellbuilder ATM interface for NETBuilder I	155Mbps (OC-3) fibre UNI	Ethernet, Token Ring	3Q 1994
DXI = Digital exchange interface UNI = User Network Interface				

spreadsheets and word-processing programs drove PC purchases.

Because ATM switches cells instead of packets and is connection-oriented rather than connectionless, it can guarantee that video frames arrive without exceeding the maximum allowable delay between frames. This ability renders ATM much better suited to multimedia than LAN technologies like Ethernet, which can't guarantee that video packets will arrive regularly.

That said, however, multimedia is a long way off when it comes to ATM LANs. Certainly it's not going to happen until most users have workstations with ATM interfaces, which isn't likely until the next generation of PCs arrives or until truly low-cost ATM gets here. Both developments still look to be several years off. Most ATM local area network and backbone switches, in fact, don't even support the ATM specs that would allow them to handle multimedia with the greatest efficiency.

Four Cell Types

There are four main types of cells that can traverse an ATM network. These correspond to the ATM adaptation layers (AALs) originally developed by the ITU-TS (the International Telecommunication Union - Telecommunications Standards sector, formerly the CCITT).

The purpose of the AALs is to let ATM switches know what kind of information is contained in a cell. Specifically, the switches needed a way to recognise that some cells, such as those carrying voice, can't tolerate much delay. Other cells, such as those loaded with LAN data, are far less

sensitive to delay. To this end, the ITU-TS defined four AALs. Type 1 specifies a connection-oriented circuit and constant-bit-rate traffic; it's appropriate for isochronous data like video or voice. Type 2 also is connection-oriented but allows for variable-bit-rate traffic; it could be used for packetised video. Types 3 and 4 are similar enough that they are always combined; they specify connectionless, variable-bit-rate traffic, such as LAN data.

Here's where the fun comes in. Since AAL 3/4 is intended for local area network traffic, it should be the logical choice for LAN switches, hubs, and adaptors. But in the interests of speeding product development, various vendors and users developed and have proposed yet another AAL. This new AAL has now been agreed upon by the ATM Forum.

AAL 5 is easier to implement than its counterparts and has gained far wider acceptance. Basically, it labels cells as not belonging to one of the other AALs. At present, most ATM LAN gear supports AAL 5 (and possibly AAL 3/4), with support for other AALs left to future versions of the products.

Open Wide

For a technology that originally started out as a way for telcos to integrate voice and data over their wide area networks, ATM has come quite a distance. Most of the recent excitement over ATM has been over its abilities to carry LAN data, but the technology has a role to play on private networks as well. In this setting, ATM switches are connected via private lines, much the way

time-division muxes are today. Traffic from the campus feeds into a switch via routers, access muxes, or hubs.

Unlike their campus counterparts, many private network switches feature both ATM and non-ATM interfaces. That's because they typically must accommodate many types of traffic. In fact, ATM private network switches are likely to carry voice from the day they're installed in the network.

A good example of the hierarchical, heterogeneous approach that some vendors are taking can be seen in Stratacom's product. The company's IPX switches act as feeder switches to its 9.6Gbps BPX ATM switch, connecting to it either via frame relay or across a high-speed ATM interface.

There are two features of particular note to Stratacom's strategy. The company is the first to implement ATM over US-style T1 speeds (1.54Mbps) in a switch, thus allowing the technology to serve as an interface to a much wider range of private networks than previously possible. T1-speed ATM is not yet an officially agreed upon standard or ATM Forum specification, but an ITU-TSS draft recommendation is expected to come up for a vote.

The other noteworthy aspect to Stratacom's approach is its view of frame relay as an ATM access technology. The payoff to this philosophy is that end-stations — including routers and hubs — don't need to migrate immediately from a packet-based architecture. Thus, end-stations can exploit ATM's efficiency and high bandwidth without adding expensive hardware.

Both Ungermann-Bass and US-based company Bolt, Beranek and Newman are

ATM Specs: Present and Pending

Back in the good old days when standards bodies like the CCITT and the IEEE ran the show, figuring out when a protocol was finished was easy: it was finished when the governing body said it was.

Unfortunately, those days are long gone. While groups like the ATM Forum shy away from the suggestion that they're involved in writing standards (instead, they're 'developing implementors' agreements'), the fact is that much of the work once performed by standards bodies has been taken over by formal and informal groups of vendors and interested users. On the plus side, this often results in a much faster turnaround time. However, it often means that outsiders find it tough to determine when a technology is ready to use.

The latter is certainly true for ATM. The basic set of standards, covering protocols and interfaces, was finished up in 1990 by the ITU-TS (International Telecommunication Union-Telecommunications Standards sector, formerly CCITT) and was updated in 1992. These specs defined ATM cell size and structure, user-to-network interface (UNI), and physical layer and data rates (122 and 622Mbps Sonet/SDH). The UNI establishes a standard way for access devices like routers and adaptor cards to connect to switches.

The ATM Forum was founded late in 1991. One of its first official acts was to agree upon UNI version 2.0. Published in June 1992, version 2.0 defines interfaces at 45 and 100Mbps (as well as the Sonet interfaces) and two interfaces for 155-Mbps (different coding schemes are used). The 100Mbps interface works with a coding scheme and fibre similar to that used for FDDI.

The 1992 UNI also calls for the use of ATM Adaptation Layer (AAL) type 5, which was originally developed by users and vendors. Unlike the four AALs developed by the ITU-TS, AAL type 5 doesn't take up any of the cell payload for formatting. The ITU is now looking to approve AAL 5 as a draft standard.

The most important feature of the 1992 UNI spec is that it defines only permanent virtual circuits, not switched ones. This means that until the spec was updated last year, there was no standard way for vendors to implement switched ATM networks. In August last year, however, the ATM Forum completed a draft version of UNI version 3.0, which supports switched

virtual circuits (although no vendors have implemented it as yet).

The signalling protocol called for by the current UNI is a variant of the ITU's draft specification Q.93B, which defines the call setup for broadband ISDN. The ATM Forum's version is both a subset and a superset of Q.93B in that the basic protocol is simpler, but includes a function that Q.93B doesn't — support for point-to-multipoint connections. This means that users can, for example, set up video broadcasts via ATM. UNI version 3.0 also allows users to employ AALs 1 through 4, as well as AAL 5.

Other ATM specifications of interest to users today include RFC 1483 from the IETF (Internet Engineering Task Force), which describes how IP packets are to be encapsulated in AAL 5 cells. The Data Exchange Interface (DXI) also is of interest; it details specifically how LAN packets are segmented into ATM cells. The ATM DXI basically tells routers how to format LAN data in a way that's recognisable by ATM DSUs. ATM DXI defines two modes. Devices that work with mode 1 can handle up to 1,024 virtual circuits, support AAL 5, and use 16-bit CRCs (cyclic redundancy checks), which effectively limits packet size to 8K. Mode 2 devices support AAL 3/4 as well as AAL 5, handle up to 16 million virtual circuits, and use 32-bit CRCs, which yields a maximum packet size of 64K.

Finally, the traffic management subcommittee of the ATM Forum has developed an approach to flow control between end-devices and the network. In essence, the group has defined the parameters for different grades of service, leaving it up to the carriers and switch vendors to specify the values of those parameters (which include average delay, range of permissible delay, and loss ratio — the percentage of cells that can be lost by the network without adversely affecting the call).

But there are plenty of gaps left to fill in, especially from the perspective of a potential user. Three stand out: lack of flow control between switches, lack of a LAN bridging spec, and lack of a quality-of-service definition.

Because flow control between switches (as opposed to between the user and the network) has yet to be worked out, there's no standardised way to handle congestion in a multiswitch network, bad

news for anyone hoping to construct a campus backbone from a variety of different switches.

The lack of a LAN bridging spec means that there's no standard way to bridge traffic over an ATM LAN. Thus, vendors have come up with proprietary schemes, which means that interoperability is a big problem (simply said, it doesn't exist). The solution, for now, is to use only one vendor's gear or avoid bridging altogether and use routing instead. But the latter means that protocols that can't be routed, such as LAT (Local Area Transport), NetBIOS, and SNA LLC2, can't travel across the backbone.

While the traffic management scheme that's been developed so far seems satisfactory to carriers, it's not at all clear that the parameters developed for user-to-network flow control in the wide area make sense for LANs. What's missing is a standardised way for a switch to provide a LAN end-station with some kind of feedback in the case of congestion.

A proposal currently before ANSI (the American National Standards Institute) defines what it calls Class Y service. (Service classes are labelled A through D and refer to way the network services traffic for the different adaptation layers. Class A corresponds to AAL 1, Class B to AAL 2, and Classes C and D to AAL 3/4 and 5.)

The Class Y proposal basically defines a type of service that features very low cell loss, variable delay, and a feedback mechanism from the network. This combination will more accurately emulate LAN traffic. The proposal before ANSI is one of several; although it's not clear at this stage how this kind of flow control will ultimately be put in place, chances are good that some version of Class Y will become part of a LAN emulation scheme.

Another problem area is the lack of definition for ATM over twisted-pair cabling. The ATM Forum recently decided to choose one of two competing proposals, one calling for 25Mbps; the other for 52Mbps, rather than adopting both.

But it's not at all clear when, if ever, there will be a set of ATM specifications that includes all these features. The twisted-pair problem is fairly simple and may be solved within a short time, but the rest of the issues could take months — or even years — to resolve.

Johna Till Johnson

also big believers in the heterogeneous approach to ATM networking. The two have joined forces to create Lightstream Corporation, whose Lightstream 2010 switch is based on BBN's Emerald technology. Like

the BPX, the Lightstream 2010 supports interfaces ranging from 56Kbps to E3 (34-Mbps) and a mix of protocols in addition to ATM, including frame relay, SNA, and HDLC (high-level data link control). The

product doesn't yet support voice and video, however, but both services will be added by the end of 1994.

Another switch that takes the multiprotocol approach is the B-STDx 9000 from

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Table 4: ATM Adaptor Cards

VENDOR	PRODUCT	WORKSTATION	ATM INTERFACE AND SPEED	COMPATIBLE SWITCHES	AVAILABILITY
Fore Systems +1-412-967-4040	SBA-100	SBus Sun Sparcstations	100Mbps and 140Mbps over fibre	Fore	Now
	SBA-200	SBus Sun Sparcstations	100Mbps and 140Mbps over fibre	Fore	Now
	ESA-200	EISA bus PCs, including HP 700 and Silicon Graphics Indigo-2	100Mbps and 140Mbps over fibre	Fore	Now
	MCA-200	IBM RS6000 and other Micro Channel PCs	100Mbps and 140Mbps over fibre	Fore	1Q 1994
	GIA-100	Silicon Graphics Indigo	100Mbps and 140Mbps over fibre	Fore	Now
	VMA-200	VME bus	100Mbps and 140Mbps over fibre	Fore	Now
	TCA-100	DEC Turbochannel	100Mbps and 140Mbps over fibre	Fore	Now
Interphase Corp +1-214-919-9000	SBus Adaptor Card	SBus Sun Sparcstations	100Mbps over fibre	N.E.T.	1Q 1994
National Semiconductor +1-408-721-5000	EISA-bus Adaptor Cards	EISA bus PCs	100Mbps	N.E.T.	4Q 1994
N.E.T +1-415-366-4400	SBus Adaptor Card	SBus Sun Sparcstations	100Mbps	N.E.T.	Now
Network Peripherals +1-408-321-7300	SBus Adaptor Card	SBus Sun Sparcstations	155Mbps over fibre, STP and UTP	SynOptics	1Q 1994
SynOptics Communications (03) 853 0799	SBus Adaptor Card	SBus Sun Sparcstations	155Mbps over fibre, STP and UTP	SynOptics	1Q 1994
Transwitch +1-203-929-8810	ATM EISA Card	EISA bus PCs	100Mbps over fibre	N.E.T. and others	1Q 1994

Cascade Communications. In addition to frame relay, this switch handles SMDS (Switched Multimegabit Data Services) via the SMDS DXI. The idea here is that SMDS and frame relay interfaces allow the switch to connect seamlessly to public services.

There's another way to access a private ATM network — via an ATM DSU. With this scheme, the DSU segments into ATM cells, allowing non-ATM devices (or devices that implement only the ATM DXI) to connect to an ATM network or switch.

Until now, the primary application for these products has been to connect routers to ATM campus networks. But DSUs are starting to be transformed into access multiplexers, performing a function on a private network similar to that of an access hub on a LAN. By statistically multiplexing data before sending it out onto the ATM network, the units can give users bandwidth efficiency and integrated access. Only two vendors make such products presently, ADC Kentrox and Digital Link Corporation.

Interoperability Issues

Network managers already sold on ATM should make sure they're well aware of interoperability problems before they rush out to deploy the technology.

Of particular concern to potential customers, according to a recent survey by the ATM Forum, is the lack of interoperability testing. One of the difficulties is that ATM silicon is available from a range of suppliers. True, multiple sources for silicon bode well for an emerging technology, since over the long term the competition keeps chip prices down (and that means lower product prices). But in the short term, a range of chips can spell trouble, because vendors may have implemented standards slightly differently.

Years ago, for example, slight differences in the way IBM and Texas Instruments implemented their 16Mbps Token Ring chips led to interoperability problems when adaptor cards from the two vendors were in the same LAN. (The problem, it turned out, was in the specification, not the chips, but it didn't come to light until versions were available from different vendors.)

Ultimately, ATM's troubles with standardisation and interoperability may give FDDI an opening. Unlike ATM, FDDI products have been on the market for years, and after a rocky start, interoperability has been demonstrated.

It's very important to keep in mind, however, that while interoperability is critical to ATM's success in the long run, the technol-

ogy can tolerate kludges far better than shared-media technologies. Every station on a shared-access LAN must implement the same protocols. That's not the case with ATM: a switch could maintain a non-standard interface to communicate with some devices and standards-based interfaces for the rest. Such a solution would be inelegant, but it would work. Given the number of products that are being offered before the ATM specs are finished, it's also a solution that is likely to be seen on many networks.

There are signs that ATM interoperability issues are getting the attention they merit. Bell Communications Research (Bellcore) is said to be putting together an ATM interoperability test lab similar to that established by Advanced Micro Devices for FDDI. In addition, the ATM Forum has formed a subcommittee in charge of interoperability testing. One of the group's goals is to decide whether to set up an ATM interoperability lab. But both efforts are decidedly future tense, and it's going to take time to work out the kinks. ATM is still far from being a quick fix.

Johna Till Johnson is editor at large for US-based Data Communications magazine, and is based in Gainesville, Florida.



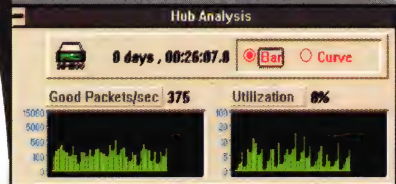
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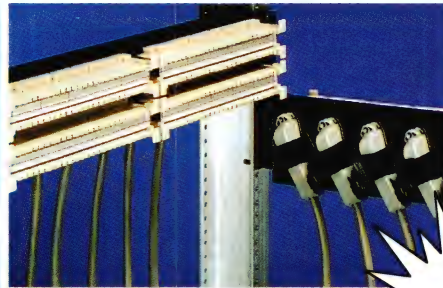
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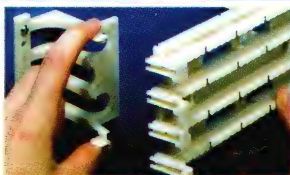
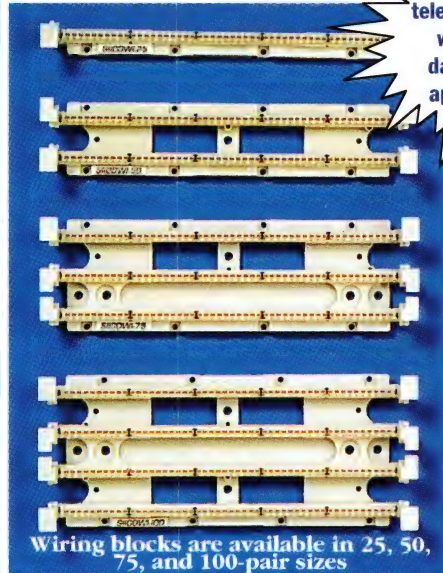
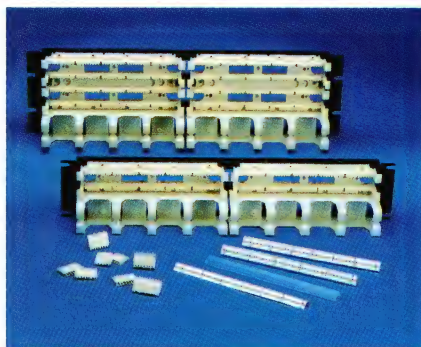
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The Fine Art of Fixing Your Fax

Many of us are plagued by multiple faxes of the same document, wasting paper and tying up the fax machine. Why does this happen, and what can be done about it? Stewart Fist explains.

Like most of us, you probably bought your office facsimile machine, plugged it in and forgot about it. That's one of the beauties of fax, and one of the main reasons why facsimile has been so successful around the world — you don't need to fiddle around with software settings for 1 stop-bit, no parity and the like. That's all done for you. The fax machine is a plug-and-play device.

Or is it? I've been plagued for the last couple of years by companies who fax me multiple copies of their press releases — I often get two of everything, and sometimes I get more. Six months ago, I vigorously berated MCI's international PR Manager, Alan Garratt, because overnight his organisation had faxed me five duplicate copies of a 20-page handout — and they'd done this many times before, and it was costing me a fortune in fax paper. At the time I was hopping mad, and asked to be taken off their mailing list — which, mercifully, they did. Well, it's hard for me to be humble, but I've now got to ring up and apologise — or, rather, partly apologise! You see, part of the problem is that they haven't set up their machine right, and the other part is that neither have I. I didn't even know I needed to. And I'd bet you didn't either.

We've all been oversold on the plug-and-play myth. A fax has defaults which can be modified in software, and part of my problem stemmed from the fact that I've never bothered to make these adjustments. Here's where the problems arise. Why, for instance, can't we get fax to transmit consistently internationally, even when the phone lines are good? And what can we do about it? When do we use the 0015 number, and why should we sometimes not?

Multiple Problems

Facsimile, as we know it today (Group 3), is a half-duplex transmission system that uses the CCITT's 1980 recommendations as well as some later additions. These additions pumped the data-rate up from 4.8 to 9.2Kbps (and more recently to 14.4Kbps), improved the image quality, and provided error correction, not just detection. The older machines can't use these later additions, naturally.

Today, a new fax machine should satisfy the CCITT/ITU recommendations for V.29, V.27, V.21/Channel 2, T.3, T.4 and the binary signalling requirements of T.30 for Group 3 fax machines — but it must also remain compatible with early machines dating from 1980. Fax always works on the lowest common denominator principle. So you can see that fax requires conformity to a healthy list of standards covering everything from the mandatory 'minimum' requirements set in 1980, to the possible 'premium' features today. And its interworking depends to a very large degree on handshaking — the



preliminary exchange of 'warbling' signals between the two machines which establishes the capabilities of each, and the condition of the transmission line.

Without this handshaking exchange, the Group 3 standards would, of necessity, be frozen in the year 1980. So with modern versions of the G3 fax, the handshaking sequence is quite extensive because the two machines are testing line conditions and exchanging a lot of information before they begin the image transfer.

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This handshaking phase is conducted at 300bps, using the old frequency-shift keying (FSK) standards (Channel 2 of V.21). Then, after they make their compromises and adjustments, they both switch to the faster PSK techniques for the image transfer. Don't forget this is a half-duplex transmission scheme where the machines alternately send and receive on the same circuit — they don't listen for a reply while they are in send-mode like modern full-duplex modems. So the fax sequence goes like this:

- 1) The originating machine dials the number, then sits and waits for a reply. If it does not get one within three seconds, it will signal its existence by transmitting occasional beeps of a 2100Hz tone.
- 2) The receiving fax picks up the line and sends a 'fax-here' signal, which is a prolonged 2100Hz tone (the standard Carrier Detect signal).
- 3) The originator then sends the following sequence: a CD (Carrier Detect) signal at 2100Hz, followed by the Non-Standard Facilities (NSI) information (identifying all the upgrades available), the Call Subscriber Identification (CSI) number and Digital Identification Signal (DSI) (this is all still done using V.21 FSK at 300bps). It then waits for a reply. Note here, that the CSI and DSI numbers are sent in ASCII code, not in the image format, so they are machine-readable. You should check that the CSI entered into each fax machine is correct — if the machine has been shifted around offices, or your fax number has changed in the last few years, you may have forgotten to modify the entered CSI. And this, as we will see later, is important.
- 4) The two machines then enter into any negotiations necessary. The receiver transmits its own Non-Standard Facilities information, and the lowest standard always wins. In this phase they establish the maximum data-rate theoretically possible, the condition of the line (they negotiate practical transmission rates by checking for errors), the resolution of the image (fine or normal?), and control features such as: do both machines simply detect errors, or can they request/provide retransmission of lost or corrupt data? There are other non-standard facilities, but these are the main handshaking negotiations that interest us here.
- 5) The originating machine now begins to send long blocks of data, which are checked by the receiver. Unless it has negotiated otherwise, at the end of each page it 'turns-around' and waits for an affirmative reply. Note that acknowledgment only confirms that each 'page' of data has been successfully received — and it is a yes-or-no confirmation. If even one line has been lost, the reply will be in the negative.

When the block-end checksums don't figure, most older G3 machines will just abandon the line of information, resulting in a white line on the fax sheet. These machines

will continue to send and receive information blocks until the end-of-file is reached, even when a substantial number of errors are notified back to the originator through negative acknowledgments (NAKs).

Data correction by retransmission is a negotiated feature, but data detection is always present in the base standard. So the originating machine will still often receive a number of page-end NAKs indicating that something went wrong — that one or more line-end checksums didn't figure.

- 6) After end-of-file is signalled, the machines will 'sign off' and the circuit will be torn down. The sending machine will then generally just go into hibernation or move on to the next automated task. But not always — and there's the rub.

The early G3 fax machines simply registered that a received image-line was in error, and abandoned it leaving a white streak across the page. Most of models in use around the world still do this. Others require (if negotiated) that the corrupted line be re-sent. However G3 machines have customisable thresholds to ensure that line conditions aren't so bad that the text will be unreadable — they add up the number of NAKs received, and if this number exceeds the threshold, they resend the whole document again.

Different models have different criteria for indicating whether there was an error in the material. Fax machines don't expect to see a 100% error-free transmission, and some manufacturers will have set their machines to accept that 5% or even 10% of the document's lines can be in error before a NAK is sent. Others set the total number of lines that can be in error before retransmission is demanded, rather than a percentage — so longer documents are more likely to be affected. If the sending machine is one of those elaborate new intelligent models with all the bells and whistles needed to fax overnight messages to long mailing lists (and these automated features are likely to be found in PC fax-cards also), then the transmission parameters may be negotiated in such a way as to ensure that the mail message always gets through.

So if the thresholds have been set too low they will send the fax again . . . and again . . . and again. It is my experience that the broadcasting fax machines used by the press offices of the world's telecom carriers and regulators are the ones set to low thresholds; if it doesn't cost you anything to use the phone network you are quite happy to resend the whole document to make sure your message got through.

This problem is one generated by improvements in fax design, and by manufacturers being thoughtful in providing user-control over a quality-of-delivery threshold — which is why it is a recent phenomenon.

"One very good [fax] manufacturer provides the capability of setting your machine

The Five Fax Groups

GROUP 1

This is the name applied to a standard that existed briefly in 1968. The CCITT's Recommendation T2 for the 'Standardisation of Black and White Facsimile Apparatus' covers these early machines. Group 1 faxes took between three and six minutes to transmit an A4 page, with even a good local telephone connection. The Americans had a previous de facto standard which was incorporated into G1; with it faxes could be sent to American machines from Europe, but not vice versa.

GROUP 2

This 1976 analogue standard is still used by some companies around the world, but not much in Australia. It takes about three minutes to scan an A4 page. However, many modern Group 3 fax machines have the old Group 2 function as well. G2 was very complicated and expensive in its day.

GROUP 3

Since 1980 this has been the digital facsimile standard used worldwide (with analogue modem transmission). These machines provide a fixed horizontal resolution of 203 dots per inch, and selectable vertical resolutions of between 192 and 384 lines per inch (but only 96 in early machines). These modems conform to CCITT standards V.27ter (2,400 and 4,800bps) and V.29 (4,800, 7,200 and 9,600bps) dibit and quad-bit PSK. Group 3 fax has been progressively updated to transmit an A4 page in about one minute at the 9,600bps rate (and more recently to 14.4Kbps). If the line is noisy they will negotiate a fall back to a lower rate — but only during the handshake period.

GROUP 4

This 1984 fully-digital fax standard was designed for the ISDN telephone system. It will run on an ISDN B-channel at 64Kbps and transmit a typical page in three seconds. The resolution is 400 by 400 dots per inch, which is higher than laser-printers. Some will have a selectable 64-level grey scale and will print-out on plain paper. G4 machines will also incorporate G3.

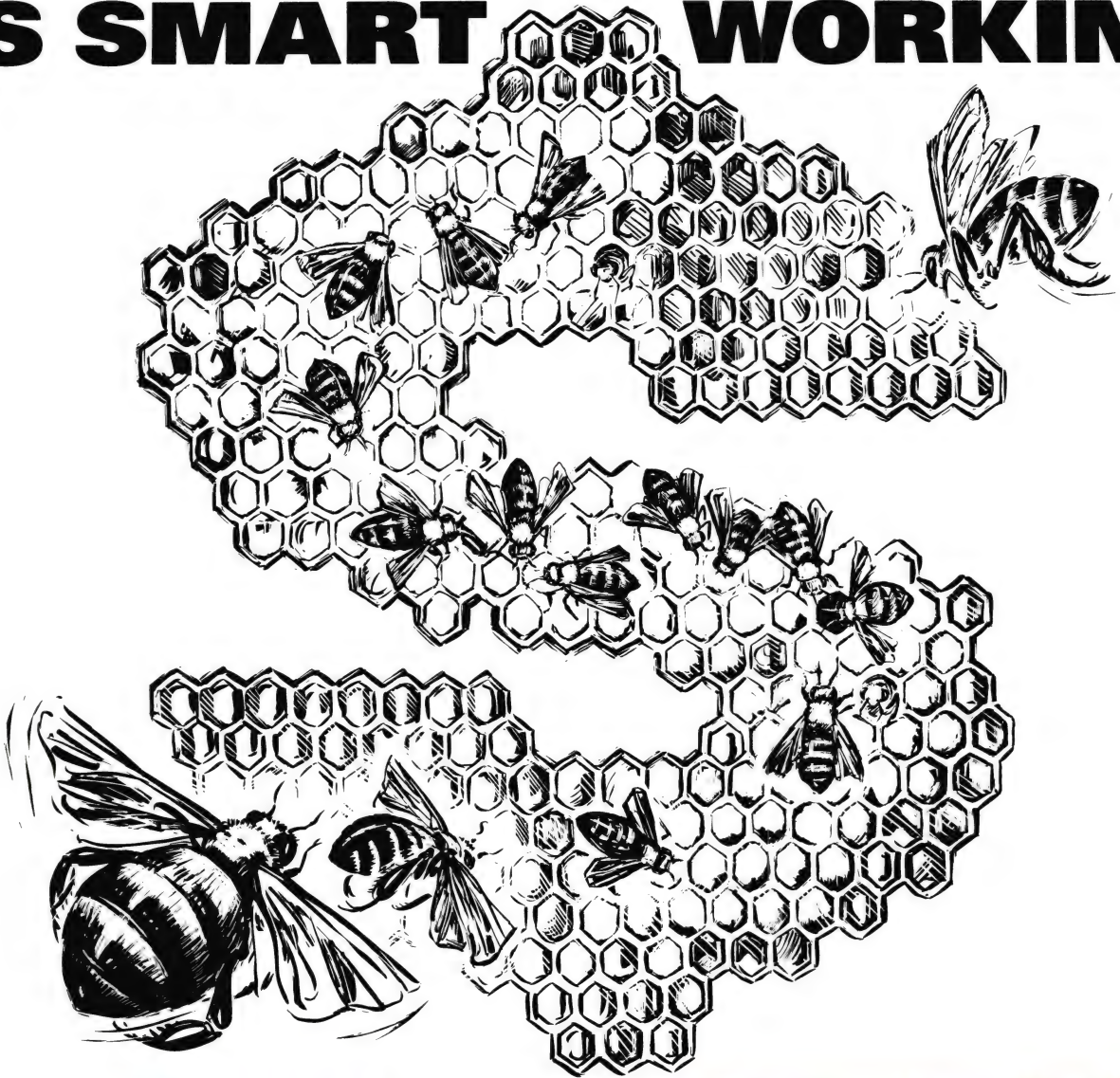
GROUP 5

This standard is currently being formulated for B-ISDN and will provide greater than 300 dot/pixels per inch resolution, and colour reproduction in 24 bits.

for thresholds from 1 to 32, 64, 96, up to 255 lines in error," according to Ross Mudie, of Telecom's National Network Information Centre. "If the received errors are below this threshold it sends back a message-confirmation signal, and if they are above the threshold it sends a Retran-Negative (RTN = NAK) signal at the end of each page of image. The RTN is interpreted by the originating machine as 'that page was not satisfactory'."

"But what then happens depends both on the software in the originating machine, and also the reaction of the receiver. If

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you've got a case where the originating machine sends the full document, then at the end of, say, 30 pages it says to itself 'that was no good' because it received a RTN message from just one page (which may have been sent because only one line was at fault) then it may resend the whole document again." It does this even though the original document, to the human eye, may look perfectly okay.

So the first practical outcome for people experiencing this kind of problem is to check the rejection thresholds of their own machine. Most modern faxes have ways of changing the factory-defaults in software, but you may need help from your vendor.

If you are constantly getting multiple resends from one source, then it's worth also advising the originating company of your problems and requesting that they do some adjustments at their end. They should adjust their resend thresholds upwards, so minor problems don't become major annoyances. But this threshold-resetting still isn't the whole answer.

An Over-Improvement

Why hasn't multiple retransmission been a noticeable problem before? Why is it a recent phenomenon? "About five years ago the lines were pretty bad, and so every manufacturer used to boost the level at which each machine was transmitting," explains Leo Rocha of Canon. "Since then, with fibre, the lines are very good. But the signal output may have still been left at the level it was five years ago, so the machines are shouting at each other. And when you shout at someone, you can't hear them properly in return — which creates all sorts of problems."

There are two parallel problems here; one with the factory-default transmit levels of your machine, and the other with the receive-sensitivity — and, of course, this applies to both parties.

You can't really expect to buy a fax machine in a shop and hope that it is at the optimal settings. In an ideal world, the transmit and receive levels will need to take into account how far you are from the exchange because of the attenuation of the line. In some cases you may need to boost the transmit power a bit to get to the exchange at the optimal level of -19dB, but generally most of the older Australian fax machines are set 6dB too high. They shout too loud. Fortunately, there's a simple way to check — Telecom provides a service for the fax industry called FOLDS (Fax On-Line Diagnostic System) and after some fun and games I finally worked out that my machine does transmit at levels 6dB too high. I managed to reset it to a lower level after long discussions on the phone to the vendor, Canon.

The other point to note is the receive-sensitivity. According to Mudie, "The receivers are generally too sensitive these days. The

Getting the FOLDS Facts

FOLDS, the Fax On-Line Diagnostic System, has not yet been released as a public facility, but it is well known in the fax industry. There are actually two FOLDS services, labelled FOLDS-A and FOLDS-B, and also an on-line manual which can be polled and downloaded to your fax.

FOLDS-A is for general test purposes. You dial up the FOLDS-A system on (03) 640 0999 and send it a full page of fax material. The system needs to operate for at least a minute to run through the full range of test parameters. It will read the receive level and return the results to you in a reply-fax automatically sent to you later, after your send-call is finished.

You'll get a rating of overall performance, readings of the transmission levels and the signal quality and information on error rate, etc. It can only do this if your fax machine transmits (as ASCII code) the correct origination fax number carried in the preliminary exchange of the hand-

shake. So make sure that you have the right number here.

FOLDS-B is for fax engineers, and it provides a test report on the line quality (mainly attenuation related to frequency), delay, echo characteristics, etc. This is esoteric stuff, and if you want to use it, you should first poll their Online Manual service (fax: 019725111) and download the 24-page manual. That will probably tell you everything you want to know.

In all cases, before you dial these numbers, you must first check that you have the TSI (Transmit Subscriber ID) correctly recorded in the memory of your fax machine (or card) in the international format (e.g. 6121234567 — without spaces). The TSI is transmitted during the handshake period in ASCII format, so it is machine readable — but note that some old fax machines won't be able to transmit this TSI and therefore can't use FOLDS.

Stewart Fist

CCITT recommendation for receiver sensitivity is -43dBm [the power level in decibels obtained when a 1 milliwatt reference level is used], which is quite sensitive. But because the analogue network was originally so 'lossy,' there were a number of manufacturers who decided that they'd make their receivers run at -48dBm, and some even at -52dBm," he says. "So these machines hear too much — they are constantly hearing ghost signals. The best treatment is to put the fax machine's fingers in its ears, (reduce the receive-sensitivity), which solves some of the problems."

The Ghost in the Machine

But where are these ghost signals coming from? This is the next problem that needs to be understood, and involves stepping back from fax technology for a minute, and looking at the voice network.

Normally, inter-exchange telephone networks are four-wire (or two fibre) circuits — with one pair (or one fibre) being reserved for the 'go' channel, and the other pair/fibre for the 'return' channel. This is done so that amplifiers and repeaters can be built into the circuits, since an amplifier needs to have a definite input and output — which means that it can't easily handle two-way electronic traffic on the same pair of wires. Similarly light pulse regenerators in optical fibre can only handle light travelling in one direction at a time.

But the analogue link between your phone and the exchange is a two-wire link used for both the 'go' and 'return' channels simultaneously. What joins these two-wire local loops to the four-wire inter-exchange network is a device called a hybrid — which,

in reality, is a multi-coiled transformer. Telephone handsets, which join a four-wire system (one pair for the earphone and another pair for the microphone) into the two-wire local loop, also need a hybrid built-in.

The point is that all phone calls involve signals transiting between two and four of these hybrids in an end-to-end connection, and each of the hybrids acts as a partial reflector of the primary signal. As you speak, each hybrid along the channel, including the end handset, will reflect back a bit of your signal. Usually you don't notice these slightly delayed echoes, and, in fact, they help produce a low-level feedback which is a desirable attribute, since it provides a 'comfort' level of signal, rather than a dead-chamber feel.

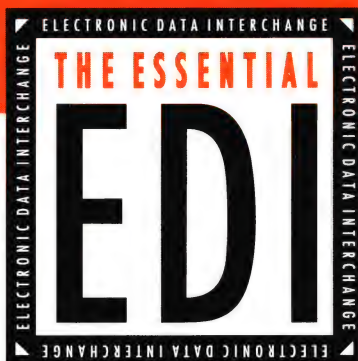
However, on long-distance calls the echoes from the far end of the channel can be annoying to the point of being disruptive — especially, for instance, if the voice traffic is being carried over satellites. For this reason, echo cancellation is added to long distance circuits. There are analogue echo 'suppression' circuits, and more recently digital 'cancellation' ones, which hold in memory a temporary profile of the primary speech patterns, look for a delayed replication of these, and remove them. Echo cancellation technology is very largely responsible for the good quality of voice reproduction we now experience on most of our international calls.

On the Rebound

Unfortunately, echo suppression and cancellation causes problems with data circuits — especially full-duplex data circuits which are relying on the deliberate echoing

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The Value and Problems of 0015

Telecom's 0015 international access number for fax transmission selects the best possible international pathway, so if both satellite and cable routes are available, it will provide you with cable.

The 0015 access line still has echo cancellation problems, but generally you will find that it is better than the alternative 0011 voice-access. The main difference is that when voice is being used across the Pacific, the carriers often steal a few bits from your channel when peak loads put pressure on their available circuits. Your conversation may initially be carrying voice in 8-bit bytes, but to gain a few extra channels the carrier might cut you back to 7-bit, which is why the voice on international circuits sometimes gets

'tinny' for a few seconds. (This isn't quite correct, but it's near enough!)

Voice circuits also use DCMS (Digital Circuit Multiplex System) which grabs up any silent bandwidth and reuses it. This sometimes results in 'voice-clipping' and introduces extra errors.

Sending faxes via 0015 avoids these problems by using channels which are reserved as full 8-bit, non-DCMS channels. But problems can arise if the machines are set at too high a transmission level, and are too sensitive in their reception. The fact that you've got the best-available channel can then actually be a problem. So if you are having trouble getting a fax through, you should try the 0011 access number.

Stewart Fist

of keystrokes or file-transmissions as a way of checking for errors. This is the famous 'Echoplex' system that we use whenever we set our modems to 'Local Echo Off.'

With Echoplex we don't want echo-cancellation on the line, so the world standard for echo cancellation systems includes a way to switch the echo-reduction system off: your modem simply sends a standardised tone of 2100Hz down the line, and the cancellation switches off. However, if the network detects a short period of non-transmission of signal, it will switch itself back on again. (Remember this point!) If it didn't do this, you couldn't switch between data and voice on the same circuit.

Now, although your fax machine is using a built-in modem to send data, it is using only half-duplex (one way at a time), and it pauses for a few milliseconds every

now and again, and waits for the other machine to respond.

As the standards have improved this 'turn-around' time has been shortened, since it is wasting transmission time. So a fax machine needs the echo-cancellation circuits to remain in use, and not be switched off. But, unfortunately, in designing the original standard, the 2100Hz tone was used as the preliminary signal which identifies one fax machine to the other. So even before the handshaking exchange really takes place, the faxes have turned off echo-cancellation, when they really need it to remain on.

The way the manufacturers have overcome this problem is through providing deliberate delays (supposedly 100ms). These are long enough to allow the echo-cancellation/off condition to time-out and re-establish itself. That's the theory anyway. But if

the line conditions are really good (which they are now with digital and optical fibre) and the transmit and receive levels of the machines at either (or one) end of the system are set too high, then ghosting echoes can travel up and down the channel during the supposed delay, and blanket the 'silence' — so the echo cancellation doesn't get re-established. This leads to a condition:

1) Where a lot of extra errors may be introduced because the receiver will constantly be getting echoes on top of the primary transmissions; and

2) Where the turn-around transmission of an Acknowledgment, a Message Confirmation, or a RTN (Retran-Neg) may be swamped by an echo of the previous command. The technicians call this 'protocol collision,' and it has the same effect as if both units are transmitting when one should be listening: the message doesn't get through.

There are two ways to overcome this problem (in addition to adjusting volume levels), according to Mudie. The first is to set the fax to respond only to the second attempt to negotiate (usually customisable in most machines), so the three-second pause between the first attempt and the second is long enough for the cancellation to restore. The second way is to dial the number manually using the attached phone handset. You wait until you've got silence, or until you get the second attempt at establishing the handshake negotiation, and by then the line should have re-established cancellation. You then hit the start button. "This fixes so many fax problems, it isn't funny," says Mudie.

Stewart Fist is a freelance journalist based in Lindfield (NSW). He acknowledges the assistance of Ross Mudie and Leo Rocha in preparing this article.

In the March edition of

AUSTRALIAN communications

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Looking for a low cost way to connect workgroups and remote sites? Stackable hubs, which are connected by cables rather than a high-speed bus, may be the ticket. Next month we take a look at stackable offerings from more than a dozen Ethernet network hub makers.

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Modems and bridges geared toward wireless internetworking are now hitting the streets, and it's time to examine what they can do. Next month we benchmark a selection of wireless internetworking equipment and explore its practicality in real network environments.

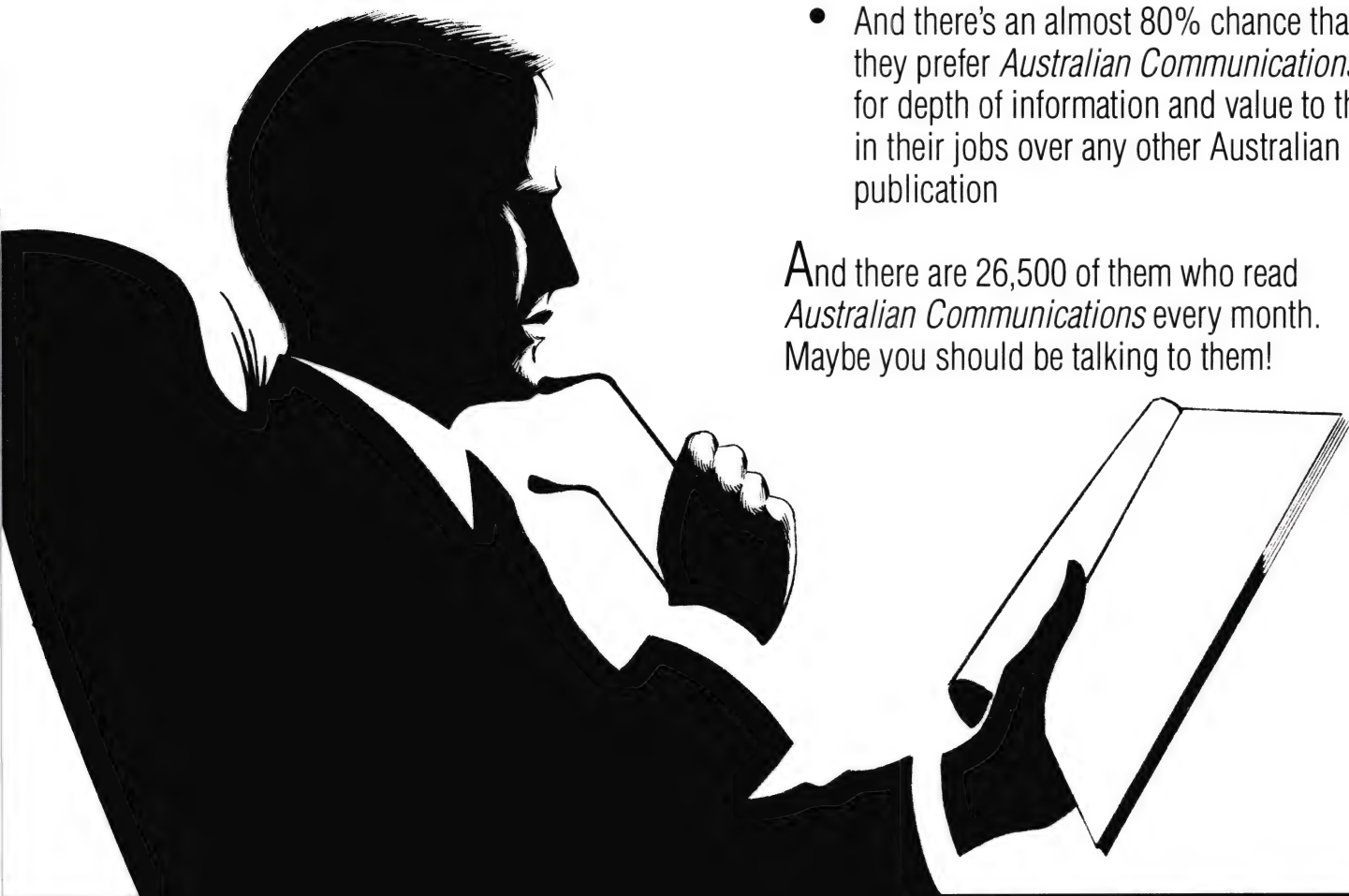
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Price Waterhouse

Xpressway for Remote LAN Access

Infotron Systems has announced the release of Gandalf's new Xpressway central-site platform for remote network access. Officials say Xpressway uses data compression and on-demand access to provide faster response times as well as lower communications costs.

They said the platform eliminates the need for special software or log-in procedures, and has built-in network management, reliability and security. It offers connectivity from multiple remote locations, combining them into a single LAN circuit and forwarding them via an internetworking backbone or high-speed connection to the enterprise backbone.

Xpressway is packaged in a rack-mountable structure with modules which plug in from the front of the unit for easy replacement, said officials. It combines high-performance RISC processors with redundant power supplies, and supports up to 128 ISDN B channels per chassis. The company says that by using multiple units up to 1,000 channels can be supported.

The platform offers 8-to-1 data compression capabilities, enabling 1Mbps of throughput over a single ISDN basic rate line. A package of expansion cards enables the system to support multiple switched services such as ISDN, Switched 56/64, X.25, T1/E1, frame relay, and PSTN. Xpressway also provides an SNMP-based integrated net-

work management system. Additionally, the new platform can accommodate two local area network access systems and optional expansion cards for Ethernet/Token Ring bridging/routing, FDDI-to-Ethernet translation bridging, X.25-to-TCP/IP or DEC LAT gateway support and asynchronous terminal server support.

Infotron Systems
(02) 417 7366

Wellfleet Multiservice Access Switches

Wellfleet Communications recently introduced its new Backbone Node Switch (BNX) family of multiservice access switches which complement the core switches found within public carrier data switching networks.

The family is a comprehensive and advanced broadband switch family which supports all major fast packet and cell switching standards, officials said.

Features of the BNX range include aggregate performance of 480,000pps; high-speed capability; advanced standards-based management and billing software; future support for multiple services including frame relay, ATM, SMDS, IP and native LAN bridging/routing; and future very high density access interface options with claimed support for up to 624 DSOs, 52 T1/E1 or 13 T3/E3 circuits.

To support ATM migration the BNX family integrates with ATM networks using an ATM interface over DS-3, moving to OC-3 rates in 1994.

Personal Videoconferencing at the Desktop

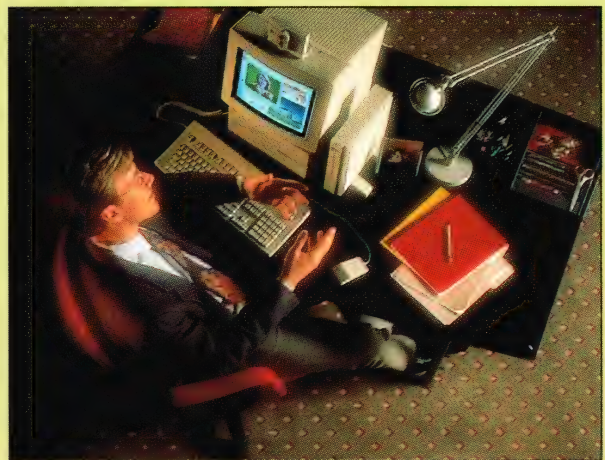
NetComm has announced the new Cameo Personal Video System version 2.1 from CLI, which runs on Apple Macintoshes and incorporates CLI's PV2 video compression technology. The system delivers full colour motion video with voice, while also permitting high-speed file exchange while video communications are active.

The Cameo system has an external video processor module and external camera module which integrate into the user's Macintosh. Using Apple's QuickTime software, an ISDN card and a video digitising card, users can get the system up and running in minutes, according to a NetComm spokesperson. A standard speaker phone enables communication with the party at the other end of the phone line, and the system requires only one BRI (Basic Rate Interface for ISDN) connection for transmission, providing savings on telephone charges.

The wide digital bandwidth of ISDN, in conjunction with the PV2 compression technology provides very high quality video and voice, the spokesperson said. A switched 56 connectivity option, using an external Data Service Unit, can further reduce costs by transmitting the video component across a separate 56Kbps channel while transmitting the voice component using an analogue or digital connection, thus increasing throughput and decreasing the connection time per call.

The system can support Ethernet networks, and users can also view themselves using the Picture-in-Picture option. Additionally, the camera can be used by other applications that support motion video.

NetComm (02) 888 5533



The new BNX family is fully manageable via Wellfleet's platform-independent Site Manager SNMP-based network management application.

Wellfleet will offer two models of the BNX family: the Backbone Link Node Switch (BLNX) and Backbone Concentrator Node Switch (BCNX).

The BLNX and BCNX are both available immediately with frame relay, and will incorporate ATM, IP as well as native LAN bridging/routing within the next 12 months, officials said.

Wellfleet (02) 955 2955

NCR ATM Switches

NCR has recently announced its UniverCell range of ATM communications switches. The new devices include an ATM switching module, ATM adaptor cards, and scalable premises switches for workgroups, departments and backbones.

Four switches are currently planned — the SmartHUB XE ATM Switch, the ATM Workgroup Switch, the ATM Departmental Switch, and the ATM Backbone Switch.



Gandalf's Xpressway can support multiple switched services

Cabletron's New Fast-Packet Switching Hub

Cabletron Systems has announced what it claims is the first multi-function hub to provide integrated bridging, routing and fast-packet switching. The new ESX-MIM is designed for Cabletron's Multi-Media Access Centre intelligent hubs, and is the first of the company's products to deploy its new high-performance switching technology, Secure Fast Packet Switching (SFPS).

The ESX-MIM provides six ports for Ethernet connectivity and one Bridge Router Interface Module (BRIM) port for connecting to ATM networks. BRIM modules provide connectivity to all standard networking technologies including ATM and FDDI. The ESX-MIM can be configured to support up to 49 Ethernet networks in a fully configured MMAC-8FNB, and provides full bandwidth-per-port wire-speed performance. The hub module is powered by dual Intel i960 processors, and supports integrated network management applications like RMON.

Cabletron's SFPS is a standards-based, connection-oriented switching implementation that leverages evolving ATM standards defined by the ATM Forum to provide high-speed switching capabilities for both cell-based and packet-based LANs. SFPS enables net managers to create multiple virtual LANs within a single physical network, and also allows the ESX-MIM to work in conjunction with existing bridges and routers.

In addition to SFPS, the ESX-MIM supports Full Duplex Switched Ethernet technology which increases Ethernet user bandwidth from 10 to 20Mbps, for point-to-point high-bandwidth applications.

The ESX-MIM can be managed by any SNMP-compliant network management software, including Cabletron's Spectrum for Open Systems. The product is priced at \$13,995.

Cabletron (02) 878 5777

Officials said that early this year SmartHUB XE users will have the ability to migrate to ATM through a 'plug-in' ATM switching module. Each four-port module will offer 800Mbps aggregate throughput, while a range of adaptor cards will provide ATM connectivity for standard bus-based systems, servers and workstations.

For the Workgroup Switch, Departmental Switch and Backbone Switch, a range of ATM interfaces from 51Mbps to 622-Mbps will be progressively announced, including support for shared and dedicated LANs, according to officials.

NCR has also announced two new bridging and routing modules for its SmartHUB XE, which can route data between networks and reduce WAN costs.

The new StarWAN Model 120 router is a board-level product which resides within the SmartHUB XE intelligent hub. It expands connectivity options for customers at hub-based sites who want to link local area and wide area networks. It routes

Ethernet, TCP/IP, OSI, StarGroup LAN Manager, DECnet, XNS, IPX, Banyan VINES and AppleTalk. Concurrent bridging via the IEEE 802.1D Spanning Tree Protocol for non-routable protocols is also supported.

The new NCR SmartHUB XE Ethernet Bridge Module helps to reduce network traffic on LANs by combining Ethernet segments into a single logical network. It can be managed via SNMP and Telnet, and also features software-controlled switching of A and B ports.

NCR (02) 964 8456

Intelligent Messaging

Banyan Systems has announced it has extended its Intelligent Messaging interface to Unix. Company officials said the interface allows all organisations with mixed Unix and PC networks to communicate through an integrated, enterprise-wide messaging information system.

Intelligent Messaging is one of Banyan's core enterprise net-

work services, and is an open platform that can provide message transport and management functions to electronic mail and mail-enabled applications from a variety of vendors, giving users the freedom to select the electronic mail front-end applications that suit them best.

The Intelligent Messaging service is an option for VINES for Unix that allows any user with access to a VINES for Unix server to send and receive e-mail throughout their enterprise network. The product is fully interoperable with all VINES, ENS and VINES for Unix Intelligent Messaging services.

**Banyan Systems
(02) 954 3228**

Stackable Hubs

Cray Communications has announced its new range of Australian-manufactured SH series of stackable Ethernet hubs.

The SH-1000 series consists of the SH-1000 12-port intelligent hub, the SH-1110 12-port intelligent hub with built-in SNMP management module, and the new SH-1010 SNMP management module as a standalone module.

Cray company officials say the SH-1000 series networks from 2 to 12 workstations fitted with 12 10Base-T ports using RJ-45 connectors plus one AUI and one BNC port for connecting thick or thin Ethernet networks. A DB50 connector and the units' plug-and-play design allows the user to stack up to 12 hubs to form a single logical repeater for 144 users.

The unit provides a front panel LED display which allows

quick monitoring of the hub's condition and each port's status.

The SH-1000 series SNMP management unit also provides LED diagnostics and full network management with both in-band and out-of-band capabilities. Rear switches set the hub ID and terminate the unit when it occupies the last position in a hub stack.

The SH-1100 12-port intelligent hub sells for \$1,533, the SH-1010 management module is priced at \$1,311 and the new Cray SH-1110 12-port intelligent hub with management module sells for \$2,800 (all prices are excluding tax).

**Cray Communications
(02) 451 6655**

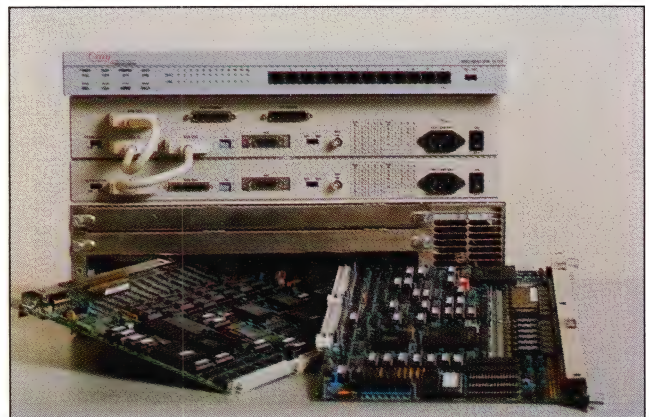
New Olicom Products

Force Technology has introduced two new products from Danish manufacturer Olicom.

The first is the new Controlled Attachment Module (CAM), which Olicom says is a cost-efficient combination of a Controlled Access Unit (CAU) and a Lobe Attachment Module (or LAM). The CAM is a fully IBM compatible intelligent Token Ring hub especially suited to smaller installations that don't require full CAU/LAM wiring.

The CAM offers immediate connectivity of up to 10 workstations, while providing full CAU compatibility, and includes full support for SNMP as well as LAN Network Manager/NetView. It also features out-of-band management, which officials said is particularly useful for branch offices.

Officials said the CAM is 'plug-and-play,' supports UTP



Cray's SH-1000 stackable hubs have built-in SNMP management

wiring and is 19" rack-mountable. As well as immediate access for 10 nodes, it is equipped with connectors for two additional LAMs, making a total of 50 possible Token Ring Lobe connections.

The second new product is the Remote CAU Bridge, which officials claim is the first Token Ring product to integrate the features of a CAU and a remote bridge. They said the new product offers the flexibility of an intelligent hub combined with the WAN connectivity of a remote bridge.

The Remote CAU Bridge connects up to 40 workstations via two LAMs. Each LAM connects up to twenty lobes, and can be either STP or UTP. The product supports IBM LAN Network Manager/NetView, SNMP-based network management systems, and Olicom network management systems. The Remote CAU Bridge handles leased data links from 9.6Kbps to 2Mbps.

Force Technology
(02) 971 1000

Multi-Protocol Print Servers

Intelligent Technologies has announced new multi-protocol Ethernet and Token Ring print servers from Swedish company AXIS Communications.

The new NPS 530 is a pocket-sized Ethernet print server measuring 2.9cm by 5.5cm by 10cm that connects directly to any printer's parallel port.

It provides up to 1,200Kbps throughput and supports NetWare, LAN Manager and LAN Server as defaults. Upgrades for TCP/IP and Apple EtherTalk are also available. The unit supports the IEEE bi-directional parallel port standard for data rates of up to 4,000Kbps in burst mode.

The NPS 650 Token Ring print server also incorporates 32-bit RISC technology, and supports NetWare, LAN Manager, LAN Server and TCP/IP.

Control of printers is possible from any point on the network using SNMP or FTP or

through the supplied PC-based software, according to company officials. Maximum throughput on two parallel ports is 8,000-Kbps in burst mode, while the single serial port can support speeds of up to 115,200bps.

The NPS 650 Token Ring multi-protocol print server is priced at \$1,650 excluding tax. The NPS 530 Ethernet multi-protocol print server costs \$850 excluding tax, with Apple EtherTalk and TCP/IP upgrade options available for \$150 each.

Intelligent Technologies
(02) 891 6010

Schlumberger T&M

Newly-formed Wedgetail Technologies has announced that it will distribute the comprehensive range of high performance test and measuring equipment from European vendor Schlumberger Technologies.

Wedgetail has been launched by the Quantek Group, and according to Quantek officials, the



The NPS 530 Ethernet print server provides 1,200Kbps throughput

test equipment division of Schlumberger is a world leading manufacturer of testing systems and instrumentation for many telecommunications manufacturers, operators and users, with a product range which addresses all major wireline, fibre optic and radio technologies.

Wedgetail Technologies
(03) 696 9334

Anti-Virus NLM

Central Point Software has released a new version of its NetWare virus protection software, Central Point Anti-Virus 2.0 for NetWare, which protects files

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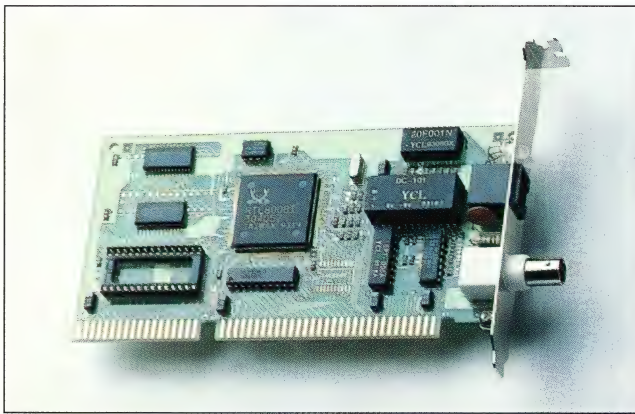
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Topware's single chip Ethernet card offers 16K of shared RAM

on NetWare 3.X and 4.X servers from infection by both known and unknown viruses.

The new version offers a new control console called Central Startup that allows centralised installation and updating of CPAV for NetWare from the administrator's PC. Using Central Setup an administrator can also control virus scanning, alerting and report generation activity for servers and workstations. Alerts can include messages to alpha-

numeric pagers, network servers or to workstations via an e-mail system such as Novell's MHS.

The anti-virus software provides support for both Novell's NetWare Management System and SNMP. It includes Central Point's Virus Analyser, an expert system that detects unknown viruses in files and boot sectors without requiring any pre-infection information, as well as scanning for over 2,000 known viruses, officials claim.

Central Point Anti-Virus for NetWare 2.0 is priced at \$1,775 per server.

Central Point Software
(02) 410 9801

Jumperless Ethernet Adaptor

Topware has released a new single chip Ethernet card, called the TE2000AD. The card features jumperless design, UTP and coax connectors, 16K of shared RAM and all LAN functions integrated in a single chip, according to company officials.

They said the advantages of the card included greater processing efficiency, lower heat emission, lower failure risk rate and lower cost. Other features of the new card include jumperless/software selectable configuration for NE1000/2000, WD-8003 or WD8013 through software embedded in the EPROM. IRQ settings, Ethernet address, input/output address, zero wait, shared RAM information set-

tings, adaptor and medium type are all configured using the software interface.

Based on industry standards, the TE2000AD is fully compatible with Novell products and with Microsoft LAN Manager. It is priced at \$162, and comes complete with a seven year replacement warranty.

Dataland (03) 416 3355

New LAN Decoder

Triticom has introduced Release 2.0 of its LANdecoder/e software-only protocol analyser for Ethernet LANs.

A range of new decode suites are available, including AppleTalk (AARP, DDP, RTMP, AEP, ATP, NBP, ADSP, ZIP, ASP, PAP, AFP), Banyan VINES (ARP, IP, RTP, SPP, IPC, ICP, RPC, SMB, Mail), DECnet Phase IV (DRP, NSP, SCP, SMB), DEC LAT, NetBIOS/NetBEUI, Microsoft/IBM Server Message Block and SNMP (including MIB II, OPF, EGP, Bridge and AppleTalk

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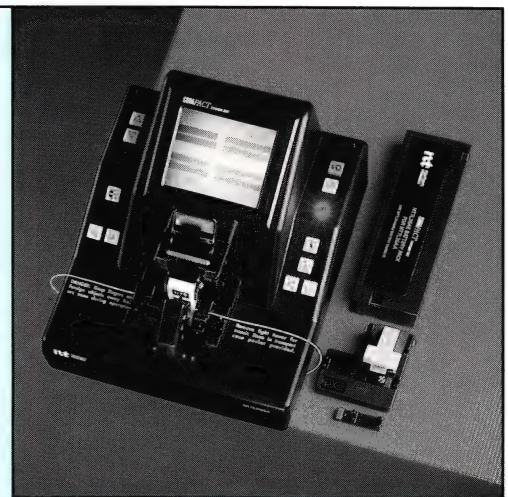
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MIBs). Company officials said the LANdecoder now decodes protocols used in most common network operating systems including NetWare, VINES, LAN Manager, LAN Server, UNIX, Apple, VMS and Windows for Workgroups.

Other new product features include: improved station filtering/triggering; frame filtering by protocol, instant summary layer change, automatic name discovery; quick access frame jumping; and additional file conversion options.

Force Technology
(02) 971 1000

Apple-Compatible Transceivers

Speedycom has released a new Australian-designed transceiver for Apple computers. The transceiver comes with either regular AUI or Apple AAUI connection leads, and allows Apples to be connected to either twisted pair or Thin Ethernet cabling.

Company officials claim the units are compact (slightly larger than a matchbox), and operate down to the Apple standard of six volts. Other features include an internal power-supply module, and CMOS chip sets to minimise power consumption and reduce heat dissipation.

The Thin Ethernet model features high-speed receiver architecture for minimum jitter, smart squelch noise filtering and improved coaxial isolation to provide less distortion from unpowered transceivers. The UTP model has SQE enable/disable, smart squelch, balanced noise filtering and compensation, and auto polarity to detect and correct inverted received data.

The transceivers can either be attached to the AUI port, or housed in a patented wall-mount unit the size of a standard power point. The units also feature diagnostic LEDs. The Thin Ethernet transceiver is priced at \$90, and the twisted pair transceiver costs \$72 (both excluding tax).

Speedycom (09) 388 1755

Windows TCP/IP Connectivity

Unixpac has announced Spry's new Windows TCP/IP connectivity applications. The AIR Series 2.0 is the first suite of transport-independent Windows connectivity applications that will ensure future compatibility and interoperability with all TCP/IP transports, said Unixpac company officials.

The applications ship with industry-standard TCP/IP transports from both Novell and Microsoft, providing native ODI and NDIS support, and each application suite also comes with the Applications-to-Socket (APP2-SOCK) interface, a Spry interface which enables the AIR series to work over any TCP/IP transport.

APP2SOCK is a public specification that provides developers with a high-layer API that bridges the AIR series and third-party Windows applications for TCP/IP networks to multiple



Speedycom transceivers link Apples to thin Ethernet cabling

TCP/IP transports. APP2SOCK supports MS Windows Sockets, Novell's WLIBSOCK and Sun-Select's TKLIB socket libraries.

The AIR series 2.0 includes usability enhancements to existing applications including Telnet, Network File Manager and AIR Mail, and also features new applications including tn3270, AIR X, AIR NVT and new Internet access applications called AIR Navigator which include AIR Mail, AIRNews and AIR Gopher.

AIR tn3270 enables users of PCs to communicate with IBM mainframes through terminal

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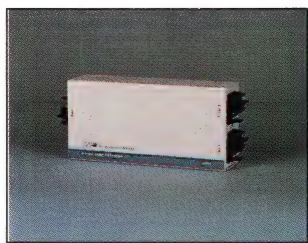
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The 5013 2-Port Lobe Expander doubles the capacity of MAU lobes

emulation in Windows. Features include custom tool bars and button bars, definable screen hotspots and keyboard maps.

AIR X is an X-Server running in Windows which allows a PC to display X applications running on remote multi-user systems. Using AIR X, users can cut and paste both text and graphics between X Clients and Windows applications and initiate remote X client sessions using preconfigured icons.

AIR NVT provides Unix users with the option for terminal emulation services over Novell's IP/SPX transport protocol. This provides users with trans-

parent integration of their host environment and their Novell local area network.

Unixpac (02) 953 8366

Windows NT Connectivity

Network Systems Technology recently released new fully-featured PC-to-mainframe communications software for Windows NT. The product, called DynaComm/Elite for Windows NT, is a 32-bit version of NetSoft's DynaComm Elite emulation program. NST officials said it features up to five concurrent host sessions, printer emulation, APPC, file transfer, flash keypad, keyboard remapping and complete HLLAPI support.

It emulates multiple IBM 3278 display stations and one or two 3287 printers, and offers concurrent 3270 (LU 2) and AP-PC (LU 6.2) connectivity via a single SNA physical unit. The software has a QuickStart feature to simplify host configuration.

DynaComm/Elite for Windows NT can be used in all PC-to-mainframe or LAN-to-mainframe networks. It can support IEEE 802.2 links and Microsoft SNA Server for Windows NT linked to the host, and is priced at \$655.

Network Systems Technology (02) 499 2900

INC Token Ring Lobe Expander

Australian manufacturer, INC, has released its new Token Ring 5013 2-Port Lobe Expander.

The product doubles the capacity of a single Multi-Station Access Unit Lobe, supporting two workstations instead of one. Company officials said it also allows cost-effective expansion without the need for additional MAUs and main ring cabling.

They said that in a typical configuration the INC 5013 connects to the lobe on an MAU to support two workstations. However, the Lobe Expander can

operate in a standalone configuration to allow communications between two workstations only, without connection to a network.

The 5013 2-Port Lobe Expander features easy installation, supports 4Mbps and 16-Mbps networks, and is fully compliant with the IEEE 802.5 Token Ring standard. The product sells for \$375 excluding tax. The 5133 Lobe Expander Terminator, for use in standalone configurations, sells for \$10 excluding tax.

INC (02) 525 8411

Ultra High-Speed Modem

Hayes has introduced the new Optima 288 V.FC + FAX modem which offers data throughput capabilities at up to 230.4-Kbps using data compression, claim company officials, who said the product is especially suited to remote LAN access and transfer of large image files.

Imagine a 2Mbps WAN Analyser the size of a Notebook.

Protocols:

X.25

SNA

SMDS

Encapsulation Analysis

Frame Relay



The RC-100

Interfaces:

RS-232

X.21

V.35

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T1/E1

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Versatile

External, RISC-based WAN Analyser which plugs into any PC (including Notebook) via the parallel port.

Powerful

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The new data and fax modem supports V.Fast Class (V.FC) for 28.8Kbps data transmission; CCITT V.42bis data compression error-control; and Group 3 fax using V.17 for 14.4Kbps fax transmission.

The modem is fully compatible with the installed base of V.32bis, V.32 and V.22bis modems. Additionally, company officials said the modem will operate at 28.8Kbps with future Hayes products once the V.34 (V.Fast) standard is approved.

Using Hayes' ESP Communications Accelerator 16-bit high speed serial card with single or dual ports enables the Optima 288 V.FC + FAX to achieve speeds of 230.4Kbps in environments such as Windows. The accelerators are half-card boards which incorporate a dedicated communications co-processor with built-in automatic flow control to ensure data integrity by eliminating buffer overrun errors.

The Optima 288 V.FC + FAX comes with Smartcom for Win-

dows LE and Windows fax communications software.

MPA International
(03) 724 4444

Ethernet Adaptor for Portables

Standard Microsystems Corporation (SMC) has introduced the SMC ElitePort parallel port adaptor, which has been designed primarily for use with laptops.

The adaptor has dual connectors, can be used with either 10Base-T or coax, and achieves high performance by automatically selecting the best available port mode — either 386SL Enhanced Parallel Port, bi-directional or the standard uni-directional.

The ElitePort has drivers to support a range of different network operating environments including NetWare IPX, NetWare DOS ODI, NetWare OS/2 ODI, DOS NDIS, OS/2 NDIS, and Packet Driver. It can be used with NetWare, LANtastic AI,

LAN Server, VINES, LAN Manager, Windows for Workgroups and Wollongong Pathway Access operating systems.

The adaptor is fully software configurable and includes a diagnostic program to test its hardware and network connection. It is particularly suitable for users of laptops and portables who have LAN connectivity requirements in the home or in the field, and whose machines cannot accommodate a conventional internal adaptor. The card weighs just 85gms, and has an external power supply to conserve laptop battery life.

The ElitePort comes with a five-year warranty, and sells for \$460 excluding tax.

SMC (02) 238 2206

Router Configuration Builder

Cisco has released the new Cisco Configuration Builder, which is designed to create Cisco router configurations that are syn-



The ElitePort adaptor provides laptop users with LAN access

chronised throughout the network and simplify the initial configuration of Cisco routers.

The Configuration Builder runs on Windows-based PCs, and includes tools for viewing, checking and changing inter-related configuration parameters. Multiple routers can be configured simultaneously from the same screen, enabling users to design and configure entire networks, rather than just individual routers.

Existing predefined configuration building blocks reduce configuration time and errors, officials say. The product also includes a duplicate address-

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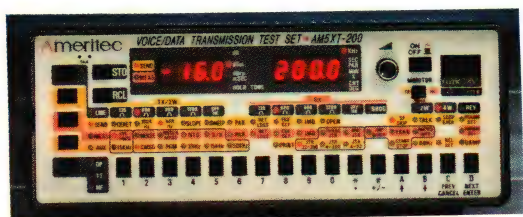
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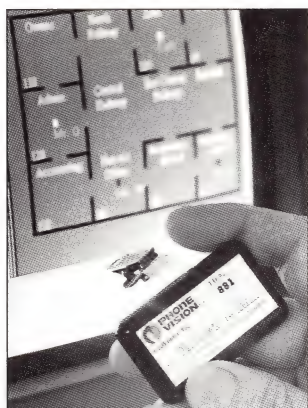
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Emulation of Telephone/Terminal equipment.

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The CallFinder tag lets companies keep track of key personnel

checking program that verifies that the addresses and/or network numbers are unique for each router configuration.

The new Cisco Configuration Builder is priced at \$760. **Cisco (02) 957 4944**

Staff Tracker

Phone Vision Australia has released a new infra-red system to

help locate key personnel within the company premises.

The new system continually tracks a person's movements through a building via a domino-sized CallFinder tag worn on an outer garment. The CallFinder tag emits encoded data via low power infra red rays to sensors in office ceilings and walls.

Phone Vision provides three mapping and tracking options for standalone or networked PCs running under Windows.

They are: PhoneMap, which provides a visual map of the office area showing the location of staff wearing CallFinder tags; PhoneList, which provides a dynamically changing list of the nearest telephone extension to the targeted person; and PhoneTalker, which provides a spoken location of the targeted person's location and extension number via a voice processing facility accessed from the PABX or key system.

Officials from the company said the Phone Vision system provides improved, more effi-

cient service combined with a reduction in unnecessary call backs, which saves money. The system uses conventional telephone twisted pair cabling.

PhoneVision Australia
(03) 562 3707

Call Manager

Metropolis WaitState has released its new Call Centre Manager, a software package comprising a number of modules designed to provide direct user access to telecommunications system control functions via a screen display and a mouse. System modules currently available include:

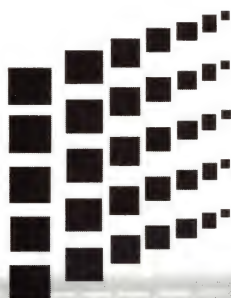
- Custom Menu Display — a powerful GUI with menu select buttons to provide access to the various modules;
- Facility Environment Display — the primary visual interface, which is customised to suit each purchaser;
- RVA Display and Message Manager — shows the num-

ber of recorded voice announcements stored on the system, and enables users to audition and change current messages;

- IVR Display — shows the configuration of interactive voice response (where users choose options from audio option menus rather than interact with a live operator) logic flow paths and which routes are being most frequently chosen by callers;
- Voice Mail Display — shows enabled voice mail boxes, owners, and number of messages;
- Reporter — provides historical reports and analysis;
- Line Monitor — shows the activity of each trunk call.

The system is Australian-designed, and also provides customers with access to Metropolis Audio's studios, where highly-trained technicians can tailor corporate messages to suit the company's market profile.

Metropolis WaitState
(03) 696 7177



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What Shall We Drive Along the Electronic Highway?

At PTC '94, the 16th Pacific Telecommunications Conference, held last month in Honolulu, communications experts from around the world spoke at great length about the communications revolution currently underway.

Of course, that such a revolution is taking place is by now an old story to readers of *Australian Communications*, most of whom are involved in the heart of this worldwide metamorphosis. But how many of us in the field stop to think about what we will be sending down these fibre optic, cellular or satellite highways?

Personally, I like to think that the multimedia age will herald the 'electronic bookshop,' by which I mean the same variety and choice of content will be available in the home as one would find in a good bookshop. The '500-channel universe,' itself a misnomer in an era of a multimedia video dial tone, will not really resemble today's television environment, as the worlds of broadcasting, telecoms and computing drift together.

As these worlds come together, the leaders of the telecommunications world are having to think increasingly about content and cultural questions. Following the \$US30 billion merger of Bell Atlantic and US cable giant TCI (Tele-Communications Inc.), *Broadcasting and Cable* magazine interviewed Bell Atlantic Chairman Ray Smith at some length, including questioning him about programming. His response to the question 'What do you think of TV programming?' was enlightening:

"Futurist George Gilder says the prurient interests of all humans are at about the same level, but the intellectual interests are at completely different levels. And so if you must produce on the broadcast model something that will appeal to everyone, you tend toward the prurient end rather than the intellectual level.

"Because the prurient end is common, the intellectual end is tremendously varied. So the solution to the violence and the banality that we see often on television is to give the viewers genuine choice. The way you do that is through switched interactivity. The moment you do that, you raise the intellectual level.

"The other aspect of it is that children will always move toward what is the lowest common denominator — not just the cheap laugh, but the violence of a pratfall."

Again, the difference for the residential user is analogous to the difference between an airport book stall and a large, well-stocked bookshop. The airport stall, like modern-day broadcasting, offers a limited range of only the most popular items. If you don't like it, too bad. Switched interactive multimedia allows you to remain a 'couch potato' if you like, but it also empowers you to do a great deal more. Ray Smith insists that the notion of a broadcasting 'channel' will be obsolete within ten years, and that we will then regard today's broadcasting technologies with the same nostalgic amusement with which we see black and white television and 8-track audio tapes.

Curiously, some of the older, cruder technologies — HF (short wave) broadcasting, cassette tapes etc. — will probably be with us for some time to come, and may well survive newer technologies such as receive-only colour television sets. Some 'lower' technologies are simply too cost-effective and omnipresent to fade away.

Likewise, one must recall all the predictions in the late 1950s and early 1960s that television would supplant and destroy radio. Yet radio continues to prosper.

Another dimension of this changing environment which has been addressed in this column in the past is the fact that the information highways, like transportation highways ('real highways'), vary tremendously in quality and level of development from one country to another. For potholes and gravel roads one may simply substitute inadequate phone networks and patchy broadcast coverage. To speak of multimedia technologies seems hugely insulting to the hundreds of millions of people who lack any real telephone service at all.

Yet here too convergence has a role to play. It is a fact in almost all developing countries that televisions are far more likely to be found in households than telephones (or, for that matter, indoor plumbing). This is not just a tribute to the popularity of television — it is also an indictment of the cost and difficulty of extending the terrestrial telecoms network, often compounded by a lack of political will and interest. TV technology is quick and cheap by comparison (and radio, or course, cheaper and easier still).

This fact bodes well for the extension of wireless telecoms services. These systems, running in parallel to traditional wireless broadcast systems, provide users with national coverage whilst the state-of-the-art terrestrial wired network is built. In other words, several developing countries are using innovative combinations of new technologies to leap-frog generations of technological growth. By doing so, they are moving rapidly to the modern telecoms environment, and then to a more secure environment for economic growth. (One of the great achievements of the past decade was the establishment of the *idea* of telecoms growth as *fundamental* to economic progress. Amazing as it may seem now, this was disputed as recently as five years ago.)

But as exciting and inevitable as the new wave of technology is, it is not entirely clear what the 500-channel universe or switched information highway is going to mean to people in Fiji, Bolivia or Gabon.

Certainly, the implications of this new universe may be fuelling the revival of the 1970s-vintage NWICO (New World Information and Communications Order) debate. While some aspects of this debate are easily dismissed, it is undeniable that these new technologies are global in scope, and hence compel those of us in the international telecoms industries to be aware of different cultural considerations.

For that matter, we don't really know what the implications of these new technologies will be for our own countries. My sense is that they will be largely positive, opening an array of new opportunities and choices. They will create a versatile, mobile communications environment that will be liberating at both the individual and workplace levels — and this liberalisation will be global in scope.

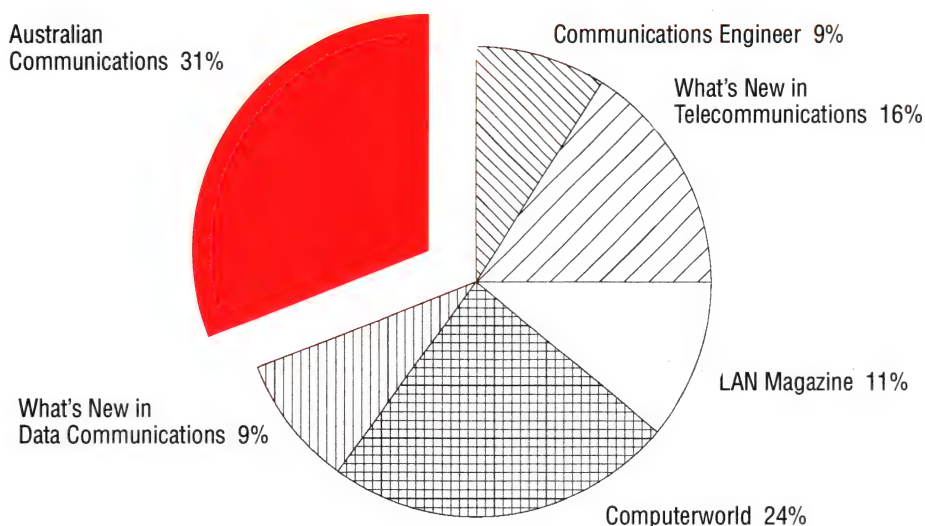
James Savage is the Assistant Director, Pacific Telecommunications Council and Editor of the Pacific Telecommunications Review.

Which publication is read by more communications professionals?

ATUG - The Exhibition and Conference of the Australian Telecommunications Users Group is unquestionably the major communications event in Australia. Visitors to the annual event are widely considered to be the region's top communications professionals, responsible for the lion's share of its networking and telecommunications purchasing.

Upon registering at ATUG'93 visitors were requested to indicate the communications/networking publications they regularly read. Judging from the **4,690*** completed questionnaires *Australian Communications* is clearly the choice of communications professionals

" I regularly read.... "



Data supplied by Riddell Exhibition Promotions, organisers of ATUG'93

* Does not include conference delegates, pre-registrations, or visitors with completed coupons from advertisements in *The Australian* and *Australian Communications*.

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From the desk of the Executive Director

More Competition Is Essential

Wally Rothwell

Athletes and organisations like ATUG cannot live on past reputations, they need to keep on delivering performances which justify their continued standing in their chosen fields of endeavour.

Elsewhere you will have read of past achievements, ongoing activities and the critical issues we will be tackling in 1994. We have developed an increasingly professional approach to producing the outcomes which our members expect, while keeping within the resources which our members are prepared to provide. In this, the fifth year of our planning cycle, the strategic plan has been refined to lead ATUG into, through and beyond the end of the duopoly in 1997.

Perception is often more important than reality in formulating peoples' opinions about everything and anything. The facilitator at our 1993 Strategic Retreat, Dr Neil Flanagan, describes this phenomenon as 'What you see is what you see,' (that is people filter reality through preconceived ideas) and he illustrates the idea with a story:

'A keen duckshooter got a new gun dog and could not wait for the duck season to begin. When it did, he was at the local lake on the first day of the season. He shot a duck, and, to his amazement, his new dog walked out on the surface of the lake, picked up the duck and brought it back to him. He was astounded but thought it might be a one-off event. He shot a second duck and the same thing happened. So he shot a third duck to put the issue beyond doubt. When the same thing happened again he was convinced that this was real. So he put the dog, the ducks and his guns in the car and drove back to his home.

Once there he woke up his next door neighbour and persuaded his friend to come back with him to the lake as he had something important to demonstrate. Returning to the lake he shot another duck, and the dog walked out on the surface of the lake to pick up the dead bird. The shooter said to his friend, "If you think that was a fluke, watch this." And he shot two more ducks, with the same result each time. The shooter then turned to his mate and said, "Well, what do you think of that?" And his friend replied, sourly, "Bloody dog can't swim."

The point is that there are many misperceptions floating around the telecommunications industry. One prevalent at present is that there is a lot of competition and, in effect the Government's intention to introduce competition into telecommunications has already been achieved. Not so. There is still very little competition about. We need more, a lot more, because it has proven to be the only really effective way to get better services at lower prices.

In our negotiations with a carrier over one of our hot issues, it was conceded that the tariffs being charged could not be justified but, as the effective monopoly supplier of this service, it was not about to give up the revenue it was getting. At least, not voluntarily.

This mirrors the FCC's experience in America where, it is alleged, that it found it could not get Ma Bell to provide figures which could justify the tariffs. Regulations could not achieve the ends the FCC sought. So, divestiture was ordered, the monopoly was exposed to competition and it was the market which forced re-tariffing to reflect the real costs of the services being provided. And it looks as though that experience has to be repeated in Australia.

Certainly it is why ATUG has pushed so hard to have competition introduced in the first place, why we continue to draw attention to the lack of competition now, and continue to lobby for increased competition in future. We are a long way from achieving ATUG's objectives. Laissez-faire will simply not do what our users want.

This is no time for complacency, nor for the misleading siren songs being peddled in some quarters that it has all been done. It has not! The end is not in sight by any means. We are only at the beginning of the end. 1994 and beyond will see some major struggles which will need all of ATUG's resources if they are to have satisfactory outcomes.

The question for some ATUG members in 1994 is whether they want to understand the realities, or to live with the illusions being so assiduously peddled that ATUG's job is done. The fact that this is being said suggests that someone, somewhere, is worried about our successes so far. In a way it is a back-handed compliment, but we do not want compliments; ATUG wants results for its members. And with our members' support, that is what we will continue to deliver through 1994 and beyond.

Wally Rothwell
Executive Director



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ATUG Satisfies Its Members

Last year ATUG surveyed its members and found that they were well satisfied with ATUG's products, services and its role in the industry. The survey was conducted by the Roy Morgan Research Centre Pty Ltd.

The two services which rated most highly amongst our members were the ATUG Newsbrief and the annual ATUG convention.

Specifically, ATUG's monthly Newsbrief was known to 98% and read by 95% of the sample surveyed — and 76% of those who read it said they were satisfied (see Table 1: Member Awareness, Use and Satisfaction Rating of ATUG Services).

The ATUG Pages section of *Australian Communications* magazine is read by 69% of members.

The annual ATUG convention was known to 99% of members, with 62% saying they had attended, and of this

number 70% claiming to be satisfied with the event.

The results also showed that the total membership was united in its recognition of ATUG's strategic function in the Australian telecommunications industry.

Of those who responded, 90% felt that ATUG generally had an important role to play. ATUG's performance in strategic roles was also considered to be good.

When provided with a list of specific benefits of membership, 86% saw their membership as providing access to up-to-date information, whilst 78% saw their membership as providing access to valuable contacts.

The survey interviewed a sample of 213 members of which 53% were users, 27% suppliers, 17% consultants and 3% trainers. More than 60% of the users interviewed were employed by large corporations of 1,000 or more employ-

ees (see Table 2: Results of Survey by Type of Member and by Organisation Category).

ATUG Plans its Future

The results of the Roy Morgan survey were discussed by the ATUG Board, during its Strategic Retreat weekend held in October.

To ensure that ATUG continues to meet our members' expectations and that ATUG maintains its strategic role within the industry, the Board has identified a number of critical issues that need addressing during the next few years. In brief, these are as follows:

- To ensure that open competition is introduced in 1997;
- To ensure that carriers adopt appropriate tariff arrangements;
- To work towards an Australian Personal Communications System that

TABLE 2: RESULTS OF SURVEY BY TYPE OF MEMBER AND BY ORGANISATION CATEGORY

PRODUCTS, ACTIVITIES AND SERVICES	AWARENESS			USE			SATISFACTION		
	User 113 %	Supplier 57 %	Consultant 37 %	User 113 %	Supplier 57 %	Consultant 37 %	User 113 Mean	Supplier 57 Mean	Consultant 37 Mean
Annual ATUG Convention	100	98	97	66	56	65	4.2	4.1	3.7
Monthly ATUG Newsletter	99	97	97	97	91	97	3.9	3.9	3.8
ATUG Seminars and Workshops	92	81	73	41	33	27	4.1	4.0	4.2
Monthly State Meetings	87	81	84	43	44	46	3.9	4.2	3.7
Peer-to-Peer Directory	75	72	81	11	23	27	4.3	4.0	4.1
Special Interest Meetings	74	72	70	28	33	35	4.0	4.0	3.6
Regular ATUG Mailouts	64	56	73	58	51	65	3.7	3.7	3.6
Advice by fax or phone	65	58	65	20	19	19	3.9	3.9	4.1
Library Service	50	40	60	8	7	16	4.4	3.8	4.0
ATUG's Free Legal Line	43	30	46	4	4	-	4.0	5.0	-
Industry Training Program Booklet	20	25	32	3	4	3	4.3	3.5	4.0
Discounts for Endorsed Products	24	16	22	6	5	11	4.5	4.3	4.7

Satisfaction Scale: 1 = Very Dissatisfied 5 = Very Satisfied

complies with a single international standard;

- To enhance competition by introducing portability, so that users can change carriers for services while still retaining the numbers for those services;
- To encourage future competition for satellite services;
- To ensure that rural and remote users are provided with access to telecommunications services comparable with those available to urban users;
- To direct the outcome of extended local call (EUCA) trials to the best long-term advantage of users; and
- To ensure the availability of the widest range of high quality international services at the lowest sustainable prices, taking into account Australia's international trade agreements.

Future Commitment

Overall, ATUG will continue to represent the interests of Australia's telecommunications users in facilitating the availability of a wide range of reliable, high quality services and products at

TABLE 1: MEMBER AWARENESS, USE AND SATISFACTION

PRODUCTS, ACTIVITIES AND SERVICES	AWARENESS 213 %	USE 213 %	SATISFACTION MEAN
Annual ATUG Convention	99	62	4.1
Monthly ATUG Newsletter	98	95	3.9
ATUG Seminars and Workshops	85	36	4.1
Monthly State Meetings	85	45	4.0
Peer-to-Peer Directory	76	17	4.2
Special Interest Meetings	73	31	3.9
Regular ATUG Mailouts	63	58	3.7
Advice by fax or phone	62	20	4.0
Library Service	49	9	4.2
ATUG's Free Legal Line	40	3	4.3
Industry Training Program Booklet	23	3	4.0
Discounts for Endorsed Products	22	7	4.5
Satisfaction Scale: 1 = Very Dissatisfied 5 = Very Satisfied			

competitive prices. Further, we will continue to monitor the competitive situation, as well as assisting our mem-

bers to make the appropriate choices so that they may benefit from the new competitive era.

AWARENESS				USE				SATISFACTION			
Private Large 39 %	Private Medium 34 %	Private Small 59 %	Public Sector 42 %	Private Large 39 %	Private Medium 34 %	Private Small 59 %	Public Sector 42 %	Private Large 39 %	Private Medium 34 %	Private Small 59 %	Public Sector 42 %
100	100	97	100	64	56	56	71	4.1	4.3	4.0	4.1
100	100	100	95	92	100	97	93	4.0	3.8	3.9	3.9
92	82	76	95	28	41	29	57	4.2	4.1	4.1	3.9
87	77	83	86	41	29	42	55	3.9	4.1	4.0	3.7
69	79	76	76	13	21	19	17	4.2	4.3	4.0	4.3
69	77	75	71	26	41	34	29	4.0	3.8	4.1	3.9
67	50	70	64	56	47	64	57	3.8	3.9	3.5	3.7
51	65	61	64	18	18	20	14	3.7	4.5	3.7	3.3
49	50	49	45	5	9	12	7	3.0	4.3	4.0	4.7
41	38	41	38	8	-	-	2	4.0	-	-	4.0
23	21	29	14	3	3	-	2	4.0	4.0	-	5.0
15	38	12	26	5	15	2	10	4.5	4.5	4.0	4.3

ATUG '94 is a Program for Smart Business

The convergence of the media, communications and computer industries means that businesses must come to terms with the new world of broadband digital technology.

In the midst of this emerging new communications platform is Telecom's Future Mode of Operations strategy. This strategy includes the upgrading of the national telecommunications network to the tune of \$3.3 billion over a five year period.

Telecom's announcement means that users will begin to see a range of new communications services such as multimedia, Pay TV, interactive services and personal communications systems being delivered into offices and homes. For some time now we have been informing users of these evolutionary changes in telecommunications. Last year, during our annual convention, ATUG '93, we briefly featured convergence and its impact on our lives.

This year, during ATUG '94, we take a broader approach to these changes and investigate how businesses can harness

the new telecommunications services to gain a competitive edge in the global marketplace. Hence the theme of the conference this year is 'Smart Communications for Smart Business.'

The program also offers practical advice to users wanting to know what is available today that could make a difference to their competitiveness in the business world right now.

The four-day program includes 70 speakers and 15 workshops. New features include an education forum, 'How To' seminars and a national technology press club forum.

Some of the topics highlighted for discussion during ATUG '94 are:

- A review of spectrum management and development;
- The role of the telecommunications industry ombudsman;
- How to protect corporate and individual privacy;
- How a computer network works;
- How a telephone network works;
- How to save money with new competitive services;

- The information infrastructure for 21st century global civilisation;
- Sydney's Olympic telecommunications strategy;
- Future services and their impact on organisation culture;
- Global technology trends;
- Convergence law;
- Communications industry salaries and benefits;
- New satellite services;
- ATM enterprise networks;
- ISDN trends, services and developments;
- Integrating wireless services;
- EMF-EMI liabilities and law;
- New ideas and tools in interactive voice response; and
- Distance learning.

With ATUG '94 now only three months away, those in the industry should ensure that they do not miss this very informative program which is truly worthy of Australia's premier event in telecommunications.

For more information contact ATUG on (02) 957 1333.

The Value of ATUG Membership

Can you afford to be without the up-to-date knowledge, provided by ATUG membership, on the evolution of convergence in the media, communications and computer industries?

As a member of ATUG you receive:

- ⇒ One year's free subscription to the monthly ATUG newsletter, 'Newsbrief';
- ⇒ One year's free subscription to *Australian Communications*;
- ⇒ Discount rates to the telecommunications event of the year, ATUG's annual four-day conference and exhibition, ATUG '94;
- ⇒ Discount rates to ATUG seminars and workshops;
- ⇒ Free admittance to ATUG special member meetings;
- ⇒ Free assistance on matters concerning telecommunications;
- ⇒ Representations of your views to Austel and the Government;
- ⇒ A forum to exchange ideas with your peers in the industry;
- ⇒ A telecommunications library service;
- ⇒ Member rates for ATUG products and services;
- ⇒ Free legal advice from ATUG's Legal Line service; and
- ⇒ An overall saving on your next communications bill due to ATUG's lobbying activities.

To learn more about becoming an ATUG member, call Owen Richards on (03) 690 6395.

Frame Relay Fills the Gap

How will users of the future access their high-speed public or private ATM network? What about users who cannot justify the cost of backbones at the speeds ATM is most efficient? How can companies operating multiple data networks consolidate them and gain the benefits of broadband networking today? In each case, the answer is frame relay.

There is no question that ATM is the optimum technology for high speed, multimedia applications. However, as ATM-based wide area networks become generally available, there will be a need to access these networks with a suitable technology. Such an access technology must have the following characteristics:

- It must enable multiple users and multiple applications to share the access bandwidth in order to provide economies;
- It must deliver bandwidth-on-demand in order to deliver high performance to bursty applications;
- It must be low in overhead so as to maximise efficiency of what may be limited bandwidth access links; and

■ It must be inexpensive to implement on Customer Premises Equipment. Only frame relay meets these requirements. Because it is a packet-mode technology, it provides bandwidth sharing and bandwidth-on-demand. Because it employs a streamlined protocol with variable-length frames, its overhead is far less than any other packet or cell-based technology.

Frame relay is easily added to CPE routers or front-end processors with a simple and inexpensive software upgrade. This is in contrast to alternative solutions which require additional, often external and separately managed, hardware. In sum, frame relay fills the gap of efficient, economical access to ATM.

Similarly, frame relay meets the needs of those who cannot justify the high cost of E3 (40Mbps), or higher, line speeds. For many users, 2Mbps represents a major improvement in capacity and performance! Again, it is frame relay which fills the gap between lower-speed traditional alternative and high-speed cell-based services.

Frame relay operates most efficiently between speeds of 64Kbps and 34-45Mbps, nicely spanning the gap be-

tween past and future speed ranges. In the real world of expensive long-distance leased lines, frame relay's range will satisfy many users indefinitely.

Many users looking for higher-performance wide area networks are also operating multiple data networks today. There is likely to be an SNA network running in parallel with a router network, which in turn is running alongside an X.25 network. Typically, there is minimal, if any, integration between the networks, all of which use leased lines (possibly in conjunction with time division multiplexers) across the wide area. Along the long path to a fully integrated broadband network, these users may wish to take the step of consolidating their data networks.

But to improve performance and reap the benefits of broadband requires a technology which can transparently accommodate virtually every popular data protocol, while delivering the bandwidth sharing and bandwidth-on-demand features discussed above. Such a consolidation is a worthwhile step in the evolution to broadband. And, once more, frame relay is there to fill the gap. **Alan Taffel, President Frame Relay Forum Worldwide**

ATUG '94

'Smart Communications for Smart Business'

**Royal Exhibition Buildings,
Melbourne
2 - 5 May 1994**

INTERCEPTION & RECORDING?

Want to find out more about call interception and recording? Or any other topic in the Telecommunications Broadcasting or Radiocommunications legislation? Then you need the EIS Electronic Law Book on disk. The new EIS Electronic Law Book has been released and now includes all the updates to the Telecommunications legislation along with Broadcasting and Radiocommunications legislation.

The publication, on a floppy disk, is available to ATUG members at the special price of \$150 including postage and packaging — a saving of \$50. A subscription including a further two updates is also available to members for \$295 — a saving of \$100.

To ensure that you have the legislation at your finger tips at all times, take advantage of this special offer. Contact the ATUG secretariat for details of how to order. Telephone (02) 957 1333.

February

14-16 TCP/IP Networks, IIT Training, Sydney. This course takes a comprehensive look at TCP/IP networking issues, covering topics such as TCP/IP addressing and address classes; routing protocols; subnet masking; protocol formats and their interpretation; how TCP/IP-related protocols work; and network management. The programme also includes practical sessions each afternoon. Also to be held in Melbourne, 21-23 February. Fee: \$1,445. Enquiries — ITT Training (02) 252 2844 Fax: (02) 247 1048.

21-22 Cabling '94, Hotel Inter-Continental, Sydney. This conference helps delegates make the right choice when installing and re-locating cabling, to ensure their organisation has a solution which encompasses flexibility, durability and efficiency. There is an optional half-day conference and workshop on fibre optics. Fee: Two-day conference \$1,395; conference and fibre optics workshop \$1,895; fibre optics workshop only \$795. Enquiries — IIR Conferences Tel: (02) 954 5844 Fax: (02) 959 4684.

28-1/3 Information Technology Law, Sheraton Wentworth, Sydney. This two-day event has been designed to give a comprehensive understanding of the ways in which information technology, commercial relationships and the law interact. Issues covered in depth include special issues in telecommunications technology; information ownership, protection and privacy; managing the legal perils of outsourcing; issues in third party maintenance contracts; and how to short-circuit software abuse. Fee: \$1,395. Enquiries — AIC Conferences Tel: (02) 210 5700 Fax: (02) 221 7773.

March

2-4 IT Security, National Convention Centre, Canberra. This two-day conference will help delegates determine their major information security concerns, and to develop policies and strategies to ensure their organisation's data is adequately protected. The programme aims to show how by learning security measures that can be taken to protect confidential information, network staff can effectively guard their organisation's data from both internal and external threats. There is also an optional third-day workshop on risk assessment. Fee: conference only \$1,395; conference and workshop \$1,895. Enquiries — IIR Conferences Tel: (02) 954 5844 Fax: (02) 959 4684.

2-4 Understanding the Telecommunications Revolution, Lakeside Hotel, Canberra. This seminar provides a practical and easy to understand overview of the telecommunications industry, technologies and applications. Day One focuses on voice communications and networks, Day Two on data communications, and the final day on emerging telecommunications technologies. Also to be held in Sydney, Brisbane and Auckland later in the month. Fee: All three days \$1,795, any two days \$1,295, any single day \$695. Enquiries — IIR Conferences Tel: (02) 954 5844 Fax: (02) 959 4684.

3-4 Pay TV, Ritz Carlton Hotel, Sydney. With the long-awaited but now imminent arrival of Pay TV communications personnel need to assess whether their organisation is positioned to take advantage of the commercial opportunities offered by this new medium. This conference helps managers formulate a Pay TV strategy for their company, discussing topics such as Pay TV licensing, regulation and management, the impact of the Pay TV environment on programming and broadcasting, and recent developments in transmission technology and multimedia. Fee: \$1,395. Enquiries — AIC Conferences Tel: (02) 210 5700 Fax: (02) 221 7773.

7-9 Internetworking, Ritz Carlton Hotel, Sydney. This event gives communications professionals the information necessary to evaluate the latest internetworking technologies. Issues covered include OSI and multiprotocol networks; the competition for dominance between SNA, TCP/IP and OSI; connecting PC-LAN servers; capacity planning for client server environments; broadband networking; the future for enterprise networks; VANs and alternatives to private networks; and management of multiprotocol networks. There will be an optional one-day workshop which looks at internetworking cost and management issues. Fee: Two-day conference \$1,395; conference and workshop \$1,995; workshop only \$795. Enquiries — AIC Conferences Tel: (02) 210 5700 Fax: (02) 221 7773.

10-13 Telex '94 and Elec-com '94, Putra World Trade Centre, Kuala Lumpur. The Telex '94 exhibition will display state-of-the-art business automation and telecommunication systems, while the Elec-com '94 exhibition is targeted at the rapidly growing market of electronics and computer users, and will feature the latest products in these fields. Enquiries — Excel Exhibitions Tel: +60 3 244 0669 Fax: +60 3 244 0670

16-17 Service Providers in the Mobiles Market, Ritz Carlton Hotel, Sydney. The new competitive Australian environment will open the way for the entrance of service providers into the market. This conference brings together the three mobile carriers as well as service providers, dealers and suppliers to examine how the mobile market will change; the resale market for mobiles; the implications for customer service; and how the new digital services will be sold to the customer. Fee: \$1,395. Enquiries — AIC Conferences Tel: (02) 210 5700 Fax: (02) 221 7773.

21-22 LAN-WAN '94, Hotel Inter-Continental, Sydney. This 3rd annual conference aims to keep delegates abreast of the latest technologies in the fast-changing world of local area and wide area networks. A forum of international experts will present new developments and applications in networking protocols, and examine technologies such as remote boundary routing, switched internetworking and wireless LANs. An optional half-day workshop will present the latest strategies in network management. Enquiries — IIR Conferences Tel: (02) 954 5844 Fax: (02) 959 4684.

21-23 Mobiles '94, Hyatt Kingsgate, Sydney. This event will focus on all the critical issues surrounding the latest technologies and applications in GSM, PCS and CDMA, and will be presented by representatives from the carriers, leading consultancies, equipment vendors, regulatory bodies and government departments. There is also a full day workshop on CDMA technology, covering RF design issues, recent trials, systems and services, and the tools available for the design of CDMA systems. Fee: Conference and workshop \$1,895; two-day conference only \$1,395; any single day only \$795. Enquiries — IIR Conferences Tel: (02) 929 5366 Fax: (02) 959 4835.

April

11-15 Investments and Joint Ventures in Asia-Pacific, Hotel Inter-continental, Sydney. Aimed at the development of international alliances and investments, this summit will bring together leading personalities, senior-level investors, bankers, financiers and business leaders from the computer, communications and telecommunications sectors from a wide range of countries within the Asia-Pacific, North America and Europe. Enquiries — IC&C World Leaders Council Tel: +1 703 476 0664 Fax: +1 703 476 2924.

25-29 Africa Telecom, Cairo International Conference Centre, Cairo. This event will attract the industry's leading speakers and 150 exhibitors from around the world. The theme for this year's conference is 'Integrating Africa Regionally and Globally,' and will cover telecommunications financing and investment in Africa, regional tariff structures, infrastructure development and broadcasting and technologies for remote areas. Africa and the Middle East region is an important telecommunications market, with an estimated demand for new telephone subscriber lines of 16 million and predicted investments of \$US24 billion before the end of the century. Fee: SFR1500. Enquiries — ITU Africa Telecom 94 Forum Tel: +41 22 730 5811 Fax: +41 22 730 6444.

May

2-5 ATUG '94, Royal Exhibition Buildings, Melbourne. With the theme of 'Smart Communications for Smart Business,' the 11th annual exhibition and conference of the Australian Telecommunications Users Group will feature a variety of international and domestic speakers and exhibitors. A special emphasis will be placed on data networking in Australia. Enquiries — ATUG Tel: (02) 957 1333 Fax: (02) 925 0880.

June

8-11 CIETE '94, Shanghai Exhibition Centre, Shanghai. The 4th International Electronic and Telecommunications Exhibition and Conference on Communication Technology will present the latest products and trends in telecommunications and electronics. Enquiries — Worldwide Conventions and Expositions Tel: +852 375 7721 Fax: +852 375 0686.

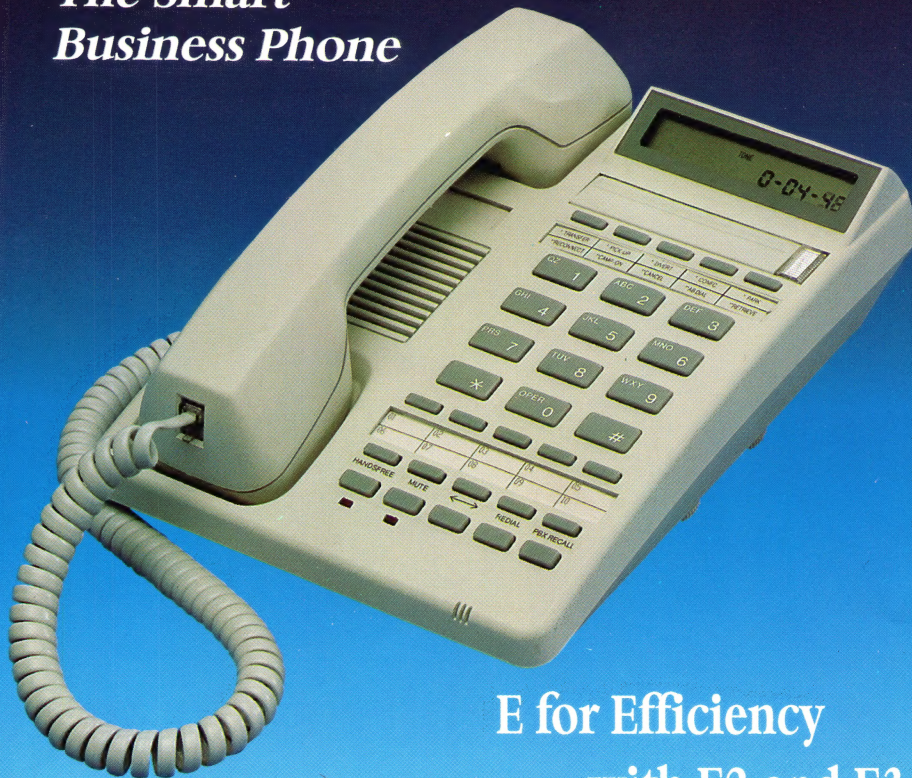
July

3-6 International Telecommunications Society 10th Annual Conference, Sydney Convention Centre, Darling Harbour, Sydney. This year's conference will look at the convergence of telecommunications, mass media and computer technologies brought about by developments in intelligent interconnected systems. Major elements of competition have been introduced, resulting in new industry structures and changes in pricing, technologies and capacity, and organisation and management. The conference will focus specifically on the areas of broadband infrastructure and user requirements; regulation of the industry; issues of competition; and the contribution of telecommunications to economic growth. Enquiries — Donald Lamberton, ITS Tel: (06) 249 3884 Fax: (06) 249 0312.

October

25-28 Communications India, Pragati Maidan, New Delhi. This trade show will display a full range of telecommunications hardware and software in the areas of voice, data, text, visual display and radio. An associated technical conference will examine cellular mobile, networking, rural telephony and network privatisation. There will also be keynote presentations by the ITU, UNIDO, the World Bank, the Indian Department of Telecommunications and the Telecom Equipment Manufacturers Association of India. India is one of the fastest growing telecoms markets worldwide. Enquiries — Exhibitions India Tel: +91 11 462 2710 Fax: +91 11 463 3506.

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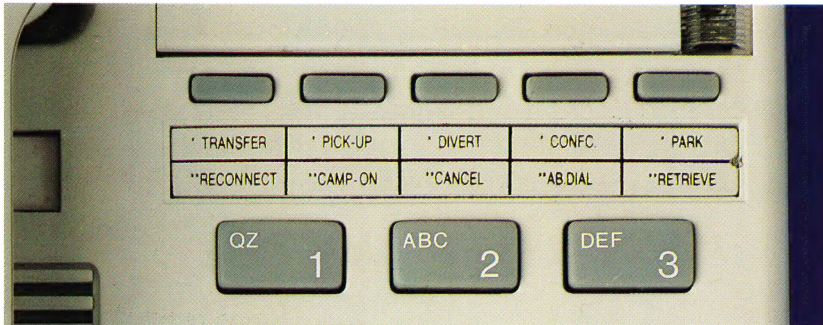
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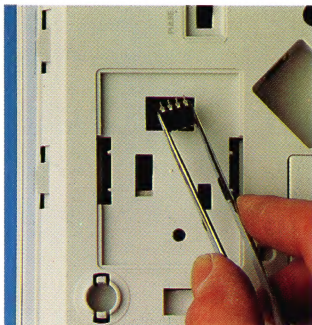
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